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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 92/04679
G06F 15/21	A1	(43) International Publication Date:	19 March 1992 (19.03.92)

(21) International Application Number: PCT/US91/06279

(22) International Filing Date: 30 August 1991 (30.08.91)

(30) Priority data:
576,689 31 August 1990 (31.08.90) US

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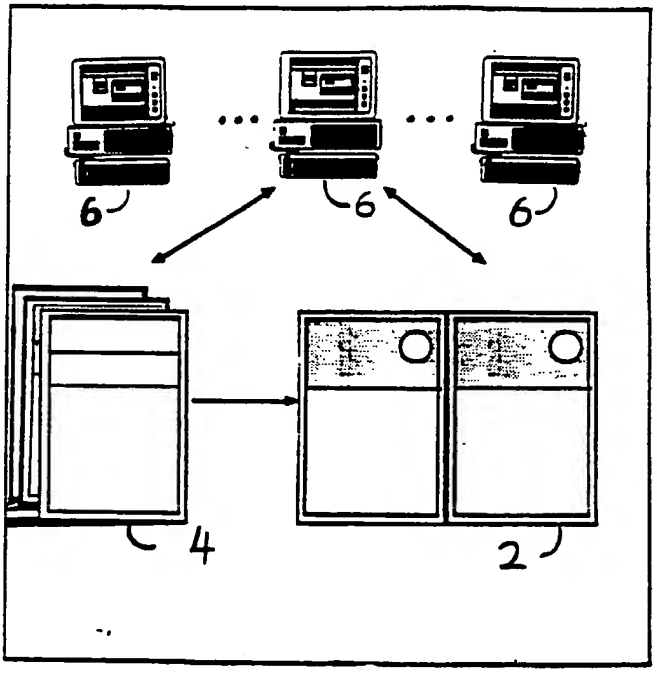
(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), HU, IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), SU+.

Published
With international search report.

(54) Title: TRANSACTION PROCESSOR

(57) Abstract

A transaction processor (2) utilized in a multi-environment computer hardware system (1) that permits an integrated way to process and track the many transaction events related to running a business or organization, such as a securities trading firm. The transaction processor (2) permits centralized storage of transaction data for integrated access by programmed modules (6) tracking different transaction events.



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TRANSACTION PROCESSOR

Field of Invention

The invention relates to multiprocessor computer systems and, in particular, to a data processing method and apparatus for integrated gathering and processing of transactions.

Background of the Invention

Organizations including businesses use computers, associated mass storage systems, and application software to aid in the management of their affairs. Records need to be kept, detailing all the transactions an organization executes. A transaction may be defined as, e.g., any buying or selling action executed by an organization. Associated with a transaction are transaction status events such as sending transaction information, like an order confirmation, or making payment for goods received. Transaction records allow organization managers to track inventory and cash flow. Data stored for each transaction can be used to maintain an organization's ledger and also to project future needs.

Securities trading organizations such as investment banking firms and brokerage houses are specific examples of organizations that record data on executed transactions. For those firms, transactions reflect the buying and selling of security products. Transactions are made on behalf of accounts maintained by the trading firm: customer accounts; and the firm's own trading accounts. Customer purchases of securities can be satisfied either directly, using securities from the brokerage organization's own account, or indirectly, with the trading firm acting as a broker. As a broker, the firm will satisfy customer trades by making secondary transactions with other security trading firms. When a security firm makes a trade for its own account or it sells securities from its own account, one refers to the firm as making a principal trade. When the firm acts as a broker, the firm makes an agency trade.

Transaction record keeping for security firms presents a challenge, because of the complex details involved with the security products traded and the need for speedy and accurate processing of information on all transactions executed by the trading firm.

Securities trading firms exchange both debt and equity type securities, including currency transactions. The products are extremely varied in their component characteristics (e.g., yield, maturity length, and dividend type). Moreover, the security products traded are constantly evolving. Common security products traded include bonds, corporate stocks, commercial paper, BNMA's, FNMA's, options, futures, high-yield currencies, interest

rate savings, various United States treasury securities and mortgage-backed securities.

When a security trading firm executes a transaction, it needs to record many trade related details, relative to three dates: trade date, settlement date and entitlement date.

On the date that the trade was executed (i.e. trade date) a security trading firm needs to record events of the trade including the type of product, the buying trader, the selling trader, the quantity of the security traded, the price, and the customer or firm account for which the trade was made.

Moreover, some securities require special record tracking. For example, a securities trading organization located in the United States might buy, over-the-counter, the bond of a foreign government, from a security-trading organization located in a third country. For this transaction, payment might be made in the currency native to the trading company from an account located at a designated bank. However, the facial denomination of the bond and the interest generated might be denoted in the currency native to the foreign government. Yields, taxes and any fees owed must also be calculated and recorded. For this example, calculations in three currencies must be maintained for a single transaction.

In addition to trade date details, a securities trading firm also needs to track settlement date transaction details. When a trade is executed, the common practice in the securities industry is not to immediately exchange securities for payment; a

transaction is executed by an agreement to later exchange securities and payment. The time period between the trade date execution of a trade and the settlement date exchange is generally short. Trades of some securities must settle by the end of the business day in which the trade was executed. Trades of other securities can settle in as many as five business days after the trade. For settlement date purposes, security trading firms track information such as the expected date of a trade settlement, the quantity of securities expected or amount of payment due, and the location of the expected security delivery.

Most securities provide entitlements to their holders. Entitlements can be an interest payment on a bond or a dividend declared by a corporation and paid on each share of corporate stock. Entitlements generally accrue on a cyclical basis. A trading firm needs to track entitlement information for all securities in accounts for which the trading firm maintains records and include the entitlement accrual date, the type of entitlement (such as interest payment or stock dividend) in the record for each account.

Moreover, there is a special need in the securities trading industry for accurate up-to-the-minute information on all trades executed by a security trading firm. Traders make split-second buying and selling decisions, based on fluctuating market conditions. To execute advantageous trades, the trader must have knowledge of the firm's securities holdings, the competing firms' offering prices and other pricing information.

For example, price information for certain securities is determined in part by the price of the firm's most recent sales. The most accurate pricings are determined by the most recent information on the trades. In addition, some trade orders can be satisfied directly, using securities from the firm's own inventory. To make sales from the firm inventory, traders need to have accurate and recent information concerning a firm's position in a given security.

Information concerning daily executed transactions are also used to forecast the end-of-day needs of the investment firm for cash and securities. For example, if a firm cannot pay for securities purchased with the funds on hand, it must borrow funds with an overnight loan. To make accurate borrowing decisions, treasury personnel need up-to-the-minute information on trades as they clear. In addition, if a firm has promised a quantity of securities to be available on a given day and the firm is short in that position, the firm must purchase those securities. A firm manager requires accurate and recent inventory information to make decisions concerning stock borrowing and loaning.

There are special characteristics of the securities trading industry that make the project of keeping up-to-the-minute records on executed trades particularly difficult. For example, the speed with which market positions change and the number of trades executed in a trading day for each branch office of a securities trading firm make record keeping for the securities industry a true challenge. On a given day, a typical "Wall Street" trading firm can easily execute tens of thousands

of trades.

In addition, in the present global economy, a record keeping system needs to be available twenty-four hours a day. A typical security trading firm trades securities around the clock in any open securities market such as those in New York, London and Tokyo. Although each branch office can perform batch processing at the end of its business day, all branches of an investment organization together need constant access to on-line information maintained by a transaction processing system.

Organizations have employed in the past a number of computer-based solutions for these transaction processing needs. The currently available solutions suffer from a number of defects that make them inefficient and undesirable to organizations like security trading firms.

The major drawback of current record keeping systems is that they do not process transaction data in real time -- that is executed trades are not entered into the system -- as they are made. Instead, records of executed transactions are saved until the end of day and entered into the system using batch processes. Batch processing is a method of scheduling and executing programs where programs run with no programmer interaction. Input is fed to the computer in batches. While most currently available systems are operating in batch mode, they are tied to the processing of the old trades and no new trades can be added to the system. Thus, the batching is performed at the end of each business day ("end-of-day").

However, end-of-day batch processing of executed transactions creates a time lag in updating a firm's data resources, so that the actual firm position in a given product is never accurately reflected until the batch processing is complete. Most currently available systems reflect actual up to the minute information only at the beginning of each new day. But in a business such as security trading, buying and selling decisions based on inventory information must be made during - not at the end of - the trading day. The currently available systems are ineffective in aiding intra-day decisions.

Moreover, the current use of batch processing is a hindrance in businesses where twenty-four-hour, round-the-clock processing capability is required. With batch processing, as it is currently employed, the system is closed to user input during a batch process. For example, a typical securities trading firm has branch offices around the world. Although each branch will close at the end of a business day and each branch can process some transactions and information in batch; the company as a whole remains open all twenty four hours each day, and needs to have its branches share common information. Thus, current systems which will not permit real-time data sharing during batch processing are a hinderance to security firm processing.

Beyond the problems of batch processing, transaction processing systems currently available do not provide for full integration of features necessary to process all events related to a transaction. For example, in the securities

trading industry, when an executed trade is entered, there is an expectation of payment either owing or to be received from the trade. The information about the trade can be used for pricing future trades. Further, the information can be used for forecasting -- to determine the need for overnight loans and end-of-day short position security purchases. When payment is finally received or securities are delivered, that information can also be used to reflect the firm inventory holdings or bank account balances.

On currently available systems, those functions of transaction booking, payable or receivable recordings, product pricing, inventory management, and bank account balance maintenance are each performed separately, using distinct non-integrated components. Data stored and used by the one component most often must be re-entered, either by-hand or by-tape, for use by another system component. The current method creates data redundancy and is slow. It cannot provide users with accurate and up-to-the-minute information on the organization.

Inflexibility is a further drawback to the currently available transaction processing systems. In the business of security trading, for example, the products available are constantly evolving and changing. For each security product, the record keeping requirements are different. The currently available systems employ codes that are written into and become part of program statements in the system components. Changing one characteristic of a product requires overhaul of the entire system's software.

Current transaction processing systems fail to harness the multi-task processing capabilities of computer technology and the method of cooperatively distributing software tasks across computer environments. Multi-task processing describes the simultaneous execution of two or more sequences of instructions, or one sequence of instructions operating on two or more sets of data, by a group of linked computers. Such a computer system will consist of a network of two or more processors.

Multi-task processing machines generally possess the ability to process events both synchronously and asynchronously. In engineering terms, synchronous processing means that, each event, or the performance of each operation, starts as a result of a clock signal. With asynchronous processing, each event, or the performance of each operation, starts as a result of a signal generated by the completion of the previous event or operation, or by the availability of the processes required for the next event or operation. In the context of computer programing, synchronously scheduled modules are linked such that one module must wait for the completion of other modules before it can begin again and process the next task. An example is a program module designed to wait for confirmation that a subsequent task has been completed without error. Asynchronously scheduled modules complete their scheduled tasks and restart without waiting for the completion of subsequent tasks.

The method of cooperative processing is to break a computer application into its component functions and distribute each component to different hardware

environments.

Summary of the Invention

The present invention comprises a transaction processor, dedicated to recording, maintaining and settling transactions. A transaction can be, e.g., any buying or selling event. With basic information about the transaction stored, the invention includes the capability to analyze and forecast using the data.

The invention comprises both computer hardware and computer software elements. Generally, the present invention comprises a computer system utilized to process transaction information. The computer system according to the present invention includes a transaction information entry module comprising:

i. a trade entry processor having an input to receive information relevant to a plurality of individual transactions and for generation of individual transaction records, one corresponding to each one of the plurality of individual transactions; and

ii. a transaction record file coupled to the trade entry processor for input and indexed storage of each one of the individual transaction records.

Moreover, the computer system according to the present invention includes transaction record processing modules coupled to the transaction record file. Each of the transaction processing modules is arranged to controllably access each one

of the individual transaction records from the transaction record file. The transaction record processing modules each include:

i. a transaction processor for correlating each one of the accessed transaction records to certain individual transaction accounts and cumulative transaction accounting and inventory records maintained by an organization; and

ii. a preselected set of individual account and cumulative accounting and inventory files coupled to the transaction processor for input and indexed storage of the correlated information to update and record the individual transaction accounts and cumulative transaction account and inventory records, as a function of the individual transaction records.

Pursuant to a feature of the present invention, a communication module is coupled to each of the transaction information entry module and the transaction record processing modules to transmit notification communications between those modules. The notification communications can include notification of storage of individual transaction records in the transaction record file. The transaction record processing modules are responsive to notification communications from the transaction information entry module to access the individual transaction records from the transaction record file, asynchronously to operation of the transaction information entry module, so that entry of information relevant to each of the plurality of individual transactions and correlating processing

and update and recordation of individual transaction accounts and cumulative transaction accounting and inventory records as a function of the individual transaction records, can be processed in an on-line operation.

A preselected set of reference data bases containing attribute information relating to data elements input to the trade entry processor, in connection with the plurality of transactions, can be coupled to the trade entry processor. The trade entry processor can access the attribute information during generation of the individual transaction records so as to include relevant attribute information in each one of the transaction records.

One feature of the invention is its use of parallel and multi-task processing hardware to create a speedy and totally integrated transaction processing system. Various time-consuming, but necessary functions of a transaction processor can be processed asynchronously or in background without forcing the user to wait for completion. However, crucial functions can be processed on-line in real time. The use of asynchronous and synchronous scheduling in multi-task processing systems gives users the ability to process transactions on-line and in real time.

Another feature of the invention is the use of cooperative processing methodology to efficiently parcel the programmed components to hardware environments directly suited to each component's function. In a multi-task processing system that employs different types of computers, such as

personal computers (PCs), and larger computers, the program elements can be distributed to take advantage of the particular strengths of each hardware element. For example, all program modules pertaining to a user interface could be distributed to the PC environment, while components that perform many calculations on large amounts of data could reside on a large mainframe computer.

Because processing can be directed automatically to the processor to which it is best suited, it is not necessary to select only one processor and data management system for a system or subsystem. Even very
small blocks of code can be sent to the processor most suited to the task at hand, whether it be to provide a user friendly interface, process a high volume of transactions, or give a user easy access to data. Large systems can be built to take advantage of the relatively low cost of PCs and mini-computers. Typical fully loaded costs (including processor, software, storage, communications hardware and so forth) per MIP (a measure of processor power) for a PC, mini-computer, and large mainframe are $5,000.00, $80,000.00 and $240,000.00 respectively. Not all computers are capable of solving all computing tasks. However, using cooperative processing techniques, processing tasks in the present invention are distributed to the lowest cost processor capable of handling the job. In addition to minimizing operating costs, the transaction processor of the present invention optimizes system performance by directing tasks to those processors most capable of providing superior performance.

The use of tightly coupled multiprocessing hardware and the use of co-operative processing are important tools not effectively utilized by current transaction processing systems. The use of multi-task processing techniques can provide speed, because many processes can be performed at once, some on-line, some in background. The processes can also be integrated. The method of cooperative process distribution allows the components to be efficiently placed in a hardware environment geared to the component's function.

A third feature of the present invention is the system of programmed communication elements that enable the distributed elements of the transaction processing system to exchange data. It is the communication system that provides the total integration of features comprising the transaction processing system.

A fourth feature of the present invention is a collection of centralized databases, containing general product information accessible to all component functions of the transaction processor. Users need only input minimum amounts of information concerning an executed transaction. The databases provide all the supplemental information needed by any of the component functions to fully process the transaction.

A distinct feature of the centralized database collection is a product classification system. The product classification system of the present invention provides routines that group products in many different inverted-tree tables by different product attributes. This method of tree-table

grouping provides a flexible way of classifying products for different system use and frees the user from hard coding those classifications into the system program modules.

The above and other features of the present invention provides a totally integrated system to record data on executed transactions. By sharing data and using a communications system that links different transaction processing functions together across hardware environments, the present invention provides a transaction processor that is quick enough to handle even the needs of a security trading firm substantially in an on-line direction.

Brief Description of the Drawings and Appendices

I. Drawings

FIG 1: depicts a hardware configuration implementing a transaction processor according to the present invention.

FIG 2: depicts a LAN hardware configuration implementing a transaction processor according to the present invention.

FIG 3: depicts a general overview of the transaction processor process flow according to the present invention.

FIG 4: depicts the general elements of a generic distribution mechanism according to the present invention.

FIG 4a: depicts a process flow of an object login

for transaction processor elements such as a router or application module.

FIG 4b: depicts a process flow when a user executes an object bind request after login.

FIG 4c: depicts a process flow of an application bind request.

FIG 4d: depicts transmission of data between a PC-workstation and a mini-computer resident application.

FIG 4e: depicts process flow when an application module fails.

FIG 5: depicts process flow of an application updating files using an IO manager.

FIG 6: depicts process flow of a store and forward system according to the present invention.

FIG 7: depicts general reference databases for the transaction processor as implemented for a securities firm.

FIG 8: depicts a typical product classification tree created by a product classification system module (PCS) according to the present.

FIG 9: depicts a flow for the creation of the PCS tree of FIG 8.

FIG 10: depicts a process flow for a trade entry

module according to the present invention, as implemented for a security exchange firm.

FIG 11: depicts data flow for the trade entry module of FIG 10.

FIG 11a: depicts the process flow for the trade generation module as shown in FIG 11.

FIG 12: depicts a data process flow of a floor entry module according to the present invention.

FIG 13: depicts a data process flow for a desk entry module according to the present invention.

FIG 14: depicts a process flow for breaksheet processing module according to the present invention.

FIG 15: depicts process flow for a front-end trade inquiry module according to the present invention.

FIG 16: illustrates a method of creating integrated payable and receivable records according to the present invention as part of the cash management system module (CAMS).

FIG 16a: depicts a flow of control for cash records received by a cash management system module (CAMS) according to the present invention.

FIG 16b: depicts a flow of control for a CAMS cash position and forecasting module.

FIG 17: depicts a position and balance (P&B) file structure and a general overview of a P&B module process flow according to the present invention.

FIG 18a: depicts balanced file positions between a firm account settlement date table and a location settlement date table, according to the present invention.

FIG 18b: depicts balances of the P&B tables between a customer account settlement date table, a product memo table and a location account settlement date table according to the present invention.

FIG 18c: depicts position and balance (P&B) file entries for settlement date set-up transaction activity according to the present invention.

FIG 18d: depicts balancing of the position and balance (P&B) files of FIG 18c after transaction input from a clearance module and a customer accounts module according to the present invention.

FIG 19a: depicts a process flow for a trade record entry on the position and balance (P&B) file structure according to the present invention.

FIG 19b: depicts a process for trade and non-trade

activity received from a mini-computer resident module.

FIG 20: depicts a process flow of a firm inventory module according to the present invention.

FIG 20a: illustrates an example of a lot processing file action of the position and balance (P&B) module.

FIG 20b: depicts a lot record movement in handling an "as of" posting to FIFO-based open and closed lots.

FIG 21a: depicts a process flow of the capture transaction function of a customer accounts module according to the present invention.

FIG 21b: The process flow of the margin calcualtion, settlement balances, exception processing, notice authorization, debt/credit interest processing, and reporting functions of a customer accounts module according to the present invention.

FIG 22a: depicts a process flow when a trade is booked on a clearance module according to the present invention.

FIG 22b: depicts a process flow of the clearance module of FIG. 22a when a trade is paired-off.

FIG 22c: depicts a process flow of the clearance

module when a trade clears.

FIG 22d: depicts a process flow of the clearance module when a failed trade clears.

FIG 23: depicts a high level system flow of a dividends, interest and redemption (DIR) module according to the present invention.

FIG 23a: depicts a process flow for creation of entitlement announcement lists for the DIR module of FIG 23.

FIG 23b: depicts a process flow for a start-up scheduling process according to the present invention.

FIG 23c: depicts a proofsheet entitlement process according to the present invention.

FIG 23d: depicts a proofsheet adjustment process according to the present invention.

FIG 23e: depicts a process flow for a DIR entitlement distribution system according to the present invention.

FIG 23f: depicts a process flow for a DIR receipt and reconciliation system according to the present invention.

FIG 24: illustrates a process flow of a general ledger interface system according to the present invention.

II. Appendicies

Appendix I: object entity relationships for generic distribution mechanism module.

Appendix II: list of possible IO Managerfile access commands.

Appendix III: lists an example of IO manager initial checking routines.

Appendix IV: an example of a data fields from an executed trade file according to the present invention.

Appendix V: an example of data fields used the cash management module of the present invention taken from the executed trade file.

Appendix VI: examples of product position codes for a transaction processor according to the present invention as implemented for a securities firm.

Appendix VII: examples of position codes as they are used in position and balance tables for the transaction processor as implemented for a securities firm.

Appendix VIII: examples of transaction activity and its affect on special memorandum account funds as used by a customer accounts module in the present invention.

Appendix IX: examples of exception processing functions to be performed by a customer account module of the present invention as implemented for a securities trading organization.

Appendix X: example of an illogical memo position.

Appendix XI: examples of data fields used by the clearance module of the present invention, taken from the executed trade file.

Detailed Description

The present invention provides a data processing system, comprising computer hardware and program elements to process transactions. The present invention allows continuous on-line processing of transactions, integrated record keeping and business function applications.

I. Hardware Elements

The present invention can be implemented in any multi-task processing environment that supports both asynchronous and synchronous scheduling of distributed processes. An example of a hardware configuration suitable for implementing the transaction processor of the present invention is shown in FIG 1. The figure describes a "three-tiered" computer architecture, named for the three distinct types of processors networked: a mainframe computer 2, as for example a mainframe sold under the trademark "IBM 3090", a mini or super mini

computer 4, as for example those sold under the trademark "IBM S/88" or "Stratus" mini-computer, and a plurality of microcomputer workstations 6, as for example those sold under the trademark "IBM PC". The PC workstations, which can be located anywhere in the world, provide data input and local updating facilities. The PC's also enable a user to access processes on the larger computers. Mini-computers, for example those sold under the trademark "Stratus" provide immediate processing for data input from the PC's.

A Stratus mini-computer environment consists of multiple Stratus units configured as a single image, through a networking device, such as those sold under the trademark "Strata-Link" and "Strata-Net". Fault tolerance is a preferred feature of the Stratus brand name computer architecture. Fault tolerance is a construction technique employing hardware redundancy -- every device such as a chip or a driver has a duplicate that will take over in the event its counterpart fails. The mainframe, such as the IBM, houses the master databases and performs calculations accessing those large massive storage structures.

For purposes of an exemplary embodiment of the present invention, the processors recommended for each of those tiers are the IBM mainframe sold under the trademark "Model 3090", running the IBM MVS/XA operating system; the Stratus mini-computer sold under the trademark "Model XA200", running the Stratus Computer, Inc. VOS operating system, and the IBM micro-computer sold under the trademark "PS2", executing the Microsoft Corporation operating system sold under the trademark "MS-DOS."

For further information on these processors or their operating systems, the reader is referred to the following publications that are hereby expressly incorporated by reference: "IBM System/370 Bibliography", document number 6024448; and "Introduction to VOS", by Stratus Computer, Inc., document number R00001.

In the hardware configuration above, the PC, Stratus minis and mainframe are linked by transmission lines. Between PC 6 and Stratus mini-computer 4 it is recommended that the transmission lines support the X.25 standard interface protocol. For links between the mainframe and the other computers, it is recommended that the transmission lines support the IBM brand protocol referred to by the name "LU 6.2".

Implementation of the transaction processor of the present invention is not limited to a three-tiered hardware configuration. The transaction processor can be implemented using any hardware configuration that supports parallel and multi-task processing. It is the parallel and multi-task processing capability -- where different functions of an application are efficiently distributed -- that permits the speedy and continuous processing of transactions as embodied in the present invention.

For example, the transaction processor also could be implemented using a LAN or local area network. FIG 2 depicts an exemplary implementation of the transaction processor of present invention in a LAN environment, such as an Ethernet brand network. The workstation 10 would access processing

functions, not through a centralized group of mini-computers, as in FIG 1, but rather to one of several LAN-minis 12, serving workstation groups. A workstation group served by one LAN mini-computer could be the users at one district office of a company, such as a Tokyo branch office. Each mini-computer performs tasks for its user group 10. The LAN mini-computer 12 would also facilitate user links to a mainframe 14 or other additional task processing minis 16. Centralized database information would be distributed to each LAN mini-computer to maintain full integration of system functions.

II. Programmed Elements

In addition to the hardware described above, the present invention comprises a number of program elements or "modules" and data storage files.

A. Overview

A general overview of the basic process for the present invention is shown in FIG 3. All of the elements mentioned will be described in more detail below. The present invention comprises three different types of software elements: front-end modules, utility modules and transaction processing modules.

In the PC environment 20 reside front-end input and user control modules that enable users to run the present invention. In an exemplary embodiment of the present invention, it is recommended that interface modules run with an interface program from the Microsoft Company sold under the trademark

"WINDOWS."

PC resident front-end modules are designed to input data 22, to view existing data 24 and monitor and control other transaction processor modules 26. The input modules 26 receive data either on-line from a user 28, or in batch processes from tape 30 or disk input 32.

Data processing is performed by transaction processing modules that reside either in a mini-computer 34 or mainframe environment 36. Critical functions requiring immediate or fault tolerant processing are performed in the minicomputer environment 34. Less critical bookkeeping functions involving larger amounts of data are performed by modules that reside on the mainframe environment 36.

The present invention also comprises a number of utility modules to facilitate transaction processing.

A generic distribution module 38 and a PC-based router module 40 facilitate communication between PC-resident and mini-computer-based modules. The generic distribution module 38 serves as a routing device to channel the flow of information between transaction processor functions resident on the mini-computer. In addition, the generic distribution module 38 performs security and log on functions, and monitors the availability of the transaction processor's programmed elements.

Store and forward modules 41, 42 facilitate communication between transaction processing

modules that reside in the mainframe environment 36 and those modules that reside either in mini-computer 34 or PC workstation 20 environments. The primary store and forward module 41 resides in the mainframe environment 36. A mini-computer resident store and forward module 42 initiates and controls the transmission of data from the mini-computer environment 54. The transaction processing modules that reside in the mini-computer environment 34 such as a trade entry module 48 described below, feed data to mainframe resident program elements, using the store and forward modules 41 and 42. All mini-computer resident feeding systems write records to a store and forward log file 43 that is read by the mini-computer store and forward module 42. The mainframe resident store and forward module 41 writes data to a number of massive storage tables 44. A store and forward notifier module 46 deposits a message to each mainframe resident transaction processing module that could be interested in the massive storage table 44 updates.

To facilitate communications from the mainframe back to the minicomputer, the present invention comprises a call minicomputer module 45.

For purposes of an exemplary embodiment of the present invention, it is recommended that the IBM brand relational data base sold under the trademark "DB2" be used to create the massive storage tables 44 that reside in the mainframe environment 36. For background information on DB2, the reader is referred to the following IBM publications which are hereby expressly incorporated by reference: "IBM DATABASE 2 Introduction to SQL" (document

number GC26-4082); "IBM DATABASE 2 Reference" (document number SC26-4078); "OS/VS2 TSO Command Language Reference" (document number GC28-0646); "TSO extensions Command Language Reference" (document number SC28-1307); "Interactive System Productivity Facility/Program Development Facility for MBS: Program Reference" (document number SC34-2089); "Interactive System Productivity Facility/Program Development Facility of MVS: Dialog Management Services (document number SC34-2137) and "DB2 Application Programming Guide for TSO and Batch Users."

For purposes of an exemplary embodiment of the invention, it is recommended that Stratus brand operating system VOS files be used to implement the store and forward log files 43 that exist in the mini-computer environment 34. The present invention also includes a number of transaction processing modules that perform the actual transaction processing and record keeping. Transaction processing modules that make heavy use of on-line, real time processing or perform critical processing that require a fault tolerant hardware architecture reside on the mini-computer environment 34, such as the fault-tolerant Stratus brand mini-computer. Transaction processing modules that access data in the massive storage tables 44, and do not perform critical real-time processing reside in the mainframe computer environment 36.

The main input processing module of the present invention comprises a group of trade entry modules 48. As implemented for a security trading firm, the trade entry modules 48 receive from workstation

resident input modules 26 all initial data on trades as they are executed on a trade date. All trades are initially entered into the transaction processor through the trade entry modules 48.

An executed trade file 50 is the primary storage area for data concerning executed trades. After processing data on an executed trade, the trade entry modules 48 cause an executed trade record to be written to the executed trade files 50. With the trade record created, the trade is "booked" on the transaction processor. The trade entry modules 48 notify other transaction processing modules such as a clearance module 52, described below, of the existence of a new trade. Other transaction processor modules requiring executed trade data simply access the central executed trade files 50 upon notification of a newly booked trade.

The trade entry modules 48 perform critical, real-time trade processing. Thus, for purposes of an exemplary embodiment of the present invention it is recommended that the trade entry modules reside in the fault-tolerant mini-computer environment 36. The mini-computer-resident executed trade files 50 can be created as a group of Stratus operating system VOS files. However, mainframe resident transaction processing modules also utilize data stored in the executed trade files 50. For those modules it is recommended that an executed trade data table be created in the massive storage tables 44. The trade entry modules 48 can write a copy of each executed trade record to the store and forward log file 43 for transmission to the DB2 massive storage tables 44. The store and forward notifier module 46 alerts other mainframe resident

transaction processing modules, such as a firm inventory module 66 described below, of the newly "booked" trade.

Other critical processing functions that require fault tolerant Stratus processing include the clearance 52 and the cash management systems 54. The cash management system (CAMS) 54 tracks the flow of cash for the firm. An integrated payables and receivables file 56 that CAMS maintains is the central firm cash flow storehouse. The clearance module 52 records and tracks clearance and settlement activities for all trades. It receives input from clearing house banks 58 and updates all firm positions. In addition, clearance sends all cash receipt records to CAMS 54. A clearance main file 60 is a central repository of pending settlement information.

Firm and customer account positions and the locations of the securities represented by those positions are maintained in position and balance files 62. Security positions are tracked by account and location on a trade date and settlement date basis. A position and balance module (P&B) 64 creates the updates. The major systems feeding data to the P&B module 64 are firm inventory 66, margins and customer accounts 68, and clearance 52. The firm inventory module 66 tracks security trades for firm accounts and calculates profits, losses and the cost of carry, based upon different lot liquidation strategies. The customer accounts module 68 maintains customer accounts in a manner similar to the firm inventory module 66.

A dividends, interest and redemption module (DIR)

70, resides in the mainframe environment 36. DIR access trade entry module 48 data from the mainframe resident executed trade table 44 and monitors all trades for entitlements due. An example of an entitlement is an interest payment on a bond or a dividend declared on common stock. DIR 70 notifies other programs such as CAMS 54, clearance 52, firm inventory 66, and margins 68, sending relevant entitlement information. The entitlement schedules that DIR maintains are the central location for entitlement information.

Most transaction processor modules described above send input to a general ledger interface module (GLI) 72. That module translates all transaction related events into accounting journal entries. The entries are written to accounting journal files 74 which reside in the mainframe environment 36.

In addition, all of the modules described above access central reference databases 76, 77 that reside in both the mainframe 36 and mini-computer 34 environments. Those databases contain general product and other information commonly used by all program elements of the transaction processor. The set of central reference databases 76 that exist on the mini-computer environment 34, is an identical copy of the databases 77 that exist in the mainframe environment 36.

B. Utility Modules

Important features of the present invention are communication and data distribution modules that enable the transaction processor to facilitate communication between modules and to integrate the

processing modules across different hardware environments.

1. Generic Distribution Mechanism

The present invention includes a generic distribution mechanism module 38 which comprises an arrangement of cooperative processes that are responsible for providing the security and communication links between workstation front-end modules and program elements that reside in the mini-computer environment 34.

An overall architecture for the generic distribution mechanism is depicted in FIG 4. The module comprises several components, each providing a distinct function. A profiler 80 is the central controlling mechanism of the distribution system. The profiler 80 views the world of the transaction processor as consisting solely of objects between which it provides network links. The definition of a network object includes hardware elements, program elements, workstation and even users. An object is any discrete entity that communicates using the network. The profiler 80 assigns a unique identification number to each object. The profilers 80 main function is to enable and manage the functioning of objects that comprise the communication network. In addition, the profiler 80 of the present invention performs security access functions.

The actual functions of the profiler 80 are distributed between it and other distinct programmed objects. However, the profiler 80 oversees and controls the communication-task

objects that are not contained within it. The profiler 80 manages the other components and the overall network based on control information and requests generated by the other objects. Due to the dynamic nature of the network, a great deal of the control and enabling information is collected at run-time and combined with static information, stored in a database 82, described below.

All objects communicate with the profiler 80 using messages called network primitives. Primitives comprise a given object's data transmission prefaced by a request header.

The profiler 80 processes these primatives which include, for example:

1) object-login requests;
2) object-logout requests;
3) object-bind requests;
4) application-bind requests;
5) object-failure-notification; and
6) date-and-time requests.

Object-login requests are generated by network objects when they attempt to log into the system. As described below, the profiler 80 assigns to the object an identification number and adds that object into the network, using the information provided by the object's request primitive.

An object-logout request signifies that the requestor is attempting an orderly network sign-off. If valid, the profiler 80 will logout all objects dependent upon the requestor object. The profiler 80 then de-registers the object from the network as will appear.

As described more fully below, an object-bind request signifies that a network object is attempting to establish a link with another object. If the request is valid, the profiler 80 will return to the requestor, the object identifier for the remote object requested and its availability status. In addition, the profiler 80 will update a list that specifies the dependencies between objects.

An application-bind request is similar to an object-bind request. The difference is that only users can make application-bind requests. The profiler 80 responds to an application-bind request by returning the names, object identifiers, and availability status of all applications that a particular user has access to through a particular workstation. The list of applications to which a user has access to at a particularly workstation is determined by a security access files in a database 82, described below.

Object-failure notification is a signal to the profiler that some object has failed to respond. On receiving notice of the reported failure, the profiler 80 notifies each object logically dependent on the failed object. The profiler 80 will then update the network database described below to reflect the object failure. The procedure as described below is similar to that of an object logout.

A time-of-day request is used by many different program elements when they send data. The profiler 80 returns the time-of-day.

All of the requests described above are initiated by the network objects. The profiler 80 is a real-time, event-driven process that is continually executing, while awaiting to receive network requests. Upon receiving a request, the profiler 80 performs rudimentary validation, such as checking that the primitive contents are consistent and then forwards the data to specific request processing routines.

Associated with the profiler 80 is a relational database 82 and a group of standard query language procedures 84 that the profiler uses to access the information stored there. All static control information needed by the profiler 80 to create and maintain the communication network is kept in the database 82.

The database information can be classified into two categories: network and security related information. Logically, the network information is organized by individual network objects as follows:

Object Network Name.
-Object ID:
-Object Type:
> USER
> WORKSTATION
> FEATURE APPLICATION (e.g. CAMS)
> INFRASTRUCTURE COMPONENT (e.g. Profiler).
-Logical name
-password (only for object type: USER)

In the database, network object data is grouped by relationships. For example, user-object information is stored according to user group and workstation group relationships. The user group

relationship consists of

-user members

-application members

-workstation group members.

The workstation group relationship consists of:

-workstation members

-application members

The objection relationships are fully depicted in Appendix I. For more information on relationship-type modeling, the reader is referred to co-pending U.S. patent application Serial No. 444,060, filed November 30, 1989 and entitled, "Computer-Aided Software Engineering Facility," which is hereby expressly incorporated by reference.

The database is initiated and maintained by a local administration facility 86. This module gives security administration personnel direct access to the database. Users can add objects or relationships and change or delete existing ones.

While the profiler maintains the network, it is the other component: routers 88, 90, 92, 94, PC interface modules 96, queues 98, 100, 102, 104, 106, 108, 110, 112, X.25-call-routers 114; and PC-based routers 116 that actually move the information throughout the system.

The PC-workstations and mini-computers are linked by standard transmission cable lines 118. For purposes of an exemplary embodiment of the present invention, it is recommended that lines capable of supporting the X.25 protocol standard be employed. X.25 is an industry term specifying the interface between data terminal equipment and data circuit equipment.

Located in each PC workstation environment is a PC router module 116 that facilitates communications from PC to minicomputer environment. All applications that reside in the workstation computer environment invoke the PC router 116 to receive and transmit data. For each workstation there is a copy of the PC-router that is configured to a specific X.25 line.

On a mini-computer, as for example a Stratus brand mini, X.25 transmission lines are connected to hardware ports, X.25 gateways 120. For each port in the present invention two program modules are attached: a PC interface (PCI) module 96 and an X.25-call-router module 114. An X.25 call-router 114 is a process used to establish a virtual circuit beween the PCI and the X.25 gateway. A virtual circuit is an independent logical path between two end-entities created for the purpose of exchanging data. Each X.25-call router 114 is assigned to send messages to a specific PCI module 96.

PCI's 96 are protocol gateway processes that provide the communication link between the low-level X.25 gateways and high-level router communication system. Protocol is an industry term defining the conventions or rules for the format and timing of messages sent and received. PCI's alleviate any format or timing differences of a message as it was sent from the PC and as it should be received in the Stratus environment. In addition, PCI's 96 perform routine security checking for all message primitives received by the X.25 gateways 120.

The central communication component in the present invention is the router system (routers 88, 90, 92 and 94). Routers are high speed switches. A router's primary function is to receive message requests from network objects and send them to specific destinations. A router is programmed to report any switching failure to the profiler 80. In addition, routers 88, 90, 92 and 94 maintain statistics used by the profiler 80 on message traffic throughout the system.

PC-based applications 122, mini-computer-based applications 124 and 126 and the profiler 80 all communicate through the router system. PC-based applications 122 can only access the router system through an X.25 gateway 120 and a PCI protocol module 96. The router system comprises the group of router switches 88, 90, 92 and 94 to which the profiler 80 has supplied access locations for all the objects in the system. Each router 88, 90, 92 and 94 is assigned by the profiler 80 to service particular network objects, such as PCI modules 96 or applications e.g. 124 or 126. Those assigned objects are local to the designated router. A local object can directly send and receive messages to and from another local object using only their common local router. For objects that are not local, an object must forward messages from its local router to the object's local router. The profiler 80 provides all connectivity information to create the router system and can dynamically change router service assignments, depending on the use statistics that the routers provide. That function known as "warm starting," provides for a restart of the router system.

Messages are sent to, from and between routers using a series of queues 98, 100, 102, 104, 106, 108, 110 and 112. On the mini-computer, queues are data storage areas, managed by the core of the operating system, allocated from the core storage pool, and used for communications between processes. For those mini-computer-resident network objects: routers 88, 90, 92 and 94, profiler 80, applications 124 and 126 and PCI's 96 -- there is an input queue dedicated to each specific object. To send data, the sending object writes the data to the receiving object's queue. For example, an application 126 does not send data to its router 94 directly, it sends data to the router's queue 108. To receive data an object, like a router 94, reads its queue.

The process flow of the generic distribution mechanism functions such as an object login, a user-login, an application bind, an object failure and a normal data transmission are depicted in FIGS 4a-e.

The data flow depicted in FIG 4a is representative of the login for application modules, PCI's, and routers. An application module 124 generates a network login request and forwards it to the queue 104 of its default assigned router 90. The router 90 reads the message header and determines that it is a profiler action request. The router 90 forwards the request to the profiler's queue 100.

Profiler 80 reads the message of its input queue 100 and then queries the database 82 for information concerning the application. The profiler checks the information received from the

application against the security information in the database 82. Once validated, the profiler 80 directs all routers (88, 90, etc.) to establish connectivity routes to the application from each of their domains. This is accomplished when the profiler 80 sends to each router (88, 90, etc.) a message primative containing information that the routers will use to update their connectivity mapping tables. Each router module 88 has within it a connectivity table, storing within it the address of modules local to each other. The profiler 80 sends each router message to the input queue 102 of its local router 88. The local router 68 updates its own table, using the message addressed to it, and forwards the other messages to the other routers.

Once connectivity to the application is established, the profiler 80 sends to the application a login acknowledgement. The message contains an object-identification number that is now assigned to the application 124 and which the application will now use in future requests. Thus, the object login function provides the important function of network hook-up and security clearance for the transaction processor. The login process is similar for all objects.

Immediately after a network object has successfully logged into the network, it must dynamically bind any remote application with which it needs to interact. This is accomplished by sending object-bind requests to the profiler 80. The binding process for both user-objects and application-objects is similar. When logging in, a user can bind for use only those applications that are

available both for his or her use and for display at a given workstation. A security manager has established security clearances for both the workstation and the user. Those access clearances are stored in the relational database 82. For all applications, the database stores a list of all other applications it uses.

FIG 4b depicts the process flow when a user executes an application bind request after login. A PC-resident router 116 takes the request and attempts to establish a virtual circuit with the PCI 96 dedicated to that particular workstation, using the X.25 gateway 120 and the PCI's X.25-call router 114. The virtual circuit establishment process is described more fully below.

Once the PCI 96 receives the full request transmission, it writes the data to the queue 102 of its local router 88. The router 88 sends the request to the queue 100 of the profiler 80.

The profiler 80 takes the request from its queue 100 and then accesses the database 82 to determine which applications this particular user and workstation combination can have access to. Associated with the user-object data is a list of all applications that the user has security clearance to access. Related to the workstation-object information in the database 82 is a list of application functions that are authorized for use on the particular workstation. The profiler module 80 matches the two relationships to determine what applications the user can access from the given workstation.

Using a message primitive, the profiler module 80 updates a security access list that is used by the workstation's PCI 96. The profiler 80 will next generate a response that contains the logical names of all processes available to the user. The response is forwarded through the router system to the PCI 96 and back to the workstation 118.

The case of one application binding itself to another is described by FIG 4c. The requesting application 124 sends an object-bind request to the profiler 80, using the router system and queues 104, 90, 102, 88, and 100. Associated with the application-object data in the database 82, is a list of other processes upon which the application object 124 depends. The profiler 80 checks the status of each of the needed applications, and adds the requesting object (i.e. application 124) to the dependency lists maintained in the database 82 for each of the objects it will use. If the binding is successful the profiler 80 will send an acknowledgement to the requesting application 124, using the router system.

Once an object is registered to the network and successfully bound, it may send, transmit and receive messages to communicate with other program modules.

The transmission of data between a PC-workstation application and a mini-computer based application is depicted in FIG 4d. A PC-based application 122, such as the front end of the trade-entry system of FIG 3, gathers data from user input to send to the mini-computer based customer trade-entry module referred to in FIG 4d by reference numeral 126.

The application sends the data to the PC-based router 116, which will create a message primitive and attempt to send the data to the mini-computer-based PCI 96 across a virtual circuit.

The PC router 116 initiates the creation of the virtual circuit by generating X.25-protocol-requests and sending them to the mini-computer. The signal is accepted by the X.25-call-router 114 which works to establish the virtual circuit between the PC-based router 116 and the PCI 96, dedicated to that workstation. When the PCI 96 is free for processing, the X.25-call-router 114 sends the request to the PCI 96 and a circuit is established.

As implemented on a mini-computer such as a Stratus brand computer, the PCI 96 employs a VOS supplied API function to read the message transmission through the X.25 gateway 120. Once the API function is initiated the X.25-call-router 114 is completely by-passed until the circuit fails and needs to be re-established. Re-establishment is completed in a way similar to the initial establishment. The API mentioned above is described in standard VOS documentation.

When a PCI 96 receives a message, it acts only as a protocol gateway -- it simply forwards the message primitive to the queue of its local router 102. The router 88 receives the message and reads the header to determine the message's destination. Aware that the application is not a module to which it has direct access, the router 88 will forward the message to the queue 108 of the local router 94 of application B 126. Application B's router 94

determines that application B 126 is a local object and it forwards the message to application B's queue 110.

Application modules also use the communication network to exchange data, as FIG 4d again shows. In passing data from application A 124 to application B 126, as for example the trade entry system notification to CAMS of a newly booked trade, application A 124 generates a message, placing the destination address of B 126 into the header. The message is transmitted to the queue 104 of A's local router 90. Application A's router 90 determines that application B 126 is not local, and forwards the message to the queue 108 of B's local router 94. B's local router 94 reads the message and forwards it to application B's queue 110. Application B 126 will subsequently process the data and return a response.

In the event of an object failure -- application workstation, or even a PCI -- the router that noticed the failure reports it to the profiler 80 which will clean up the failure and notify related objects. This procedure includes deleting all connections to the object and preparing for the object's re-initialization. FIG 4e also depicts the process flow when an application module fails. The same scenario applies in other failure instances such as when a user fails to sign-off or a utility object such as a PCI fails.

In FIG 4e, application B 126 attempts to access failed application A 124. A's router 90 with the request from application B, sends a message to

determine whether application A 124 is not running or if its queue 112 is full. Both are failure conditions. When application A 124 does not accept the request, A's router 90 sends a failure-notification to the queue 100 of the profiler module 80.

The profiler 80 validates the message using the database 82 and performs a number of other steps. First, it instructs all routers (88, 90, 92, 94, etc.) to delete connectivity to the failed object. The profiler 80 accomplishes the task by sending to each router (88, 90, 92, 94, etc.) new connectivity table inserts that omit links to the failed object. The profiler 80 will next log-out all objects that are dependent upon the failed object. The profiler 80 performs the same steps as above, for each of the objects appearing on the failed object's dependency list. As described above, dependency lists for all network objects are created by the profiler 80 and stored in the database 82.

In the event that a workstation or communication link to a workstation 118 fails, the PCIs 96 tied to that workstation would report the failure to the profiler 80 in the same way the router did in the previous example, with the same outcome. In the case of a failed workstation, the profiler 80 will log-out all applications dedicated only to that user.

2. IO Manager

Distinct from the generic distribution mechanism module 38 described above, a feature of the present invention is a uniform method of file access used

by all applications resident on the mini-computer, as depicted in FIG 5. To access data in a file, according to the present invention, each transaction processing module 130 calls upon a copy of a utility module referred to as IO manager routine 32 to access files 136. One copy of the IO Manager 132 is bound to each transaction processing module 130. Each copy of the IO Manager 132 has associated with it one or more files comprising an IO control table 134. The IO control table 134 contains access codes and data relevant to all the files that a particular transaction processing module will access. The IO control table 134 allows a generic copy of the IO manager module 132 to perform as an access module dedicated to a specific transaction processing module

IO manager module 132 has a set of commands -- read, write, insert (update), start, commit and add that correspond to file access commands provided by the operating system. A list of sample file access commands (for a system implemented in the Stratus) is shown in Appendix II. It is the IO manager 132, rather than the transaction processor modules 130, that handle the different file access constraints imposed by a given operating system. As implemented in the three-tiered hardware environment depicted in FIG 1, the IO manager 132 is an external procedure module coded in a high-level language such as PL/1.

Associated with the IO manager module 132 for each application is the IO control table 134. Those tables 134 contain location addresses for files accessed by a transaction processing module 130 plus information concerning the organization of

those files. Any restrictions on file access imposed on transaction processing module 130 access by system management, are also contained in the IO control table 134, as well as a flag on whether store and forward logging is to be performed in addition to accessing a particular file. The concept of store and forward logging is explained more fully below.

The process flow of an application updating a record in a file using a copy of the IO manager module is shown by FIG 5. An transaction processing module 130 such as the trade entry system in FIG 3, passes to its copy of the IO manager 132, an instruction to complete the file access, (e.g., the file name, the information to be updated, and the task command (i.e. update)). The IO manager module 132 will reference its IO control table 134 to find the location of a desired file 136 and other file update information such as the restrictions imposed upon access to that file by system management.

Using the IO control table 134 information, the IO manager 132 will pass all access commands on to an appropriate operating system file access routine 138 for processing. These operating system access routines 138 perform the actual file access for data input and for output (IO). However, before the call is passed to those sub-routines, the IO manager module 132 performs some initial input validation. Appendix III shows the extent of this initial checking. Once the check is complete and valid the operating system performs the corresponding file IO 138.

The IO manager module 132 creates an audit trail by first reading the file 136 record and writing a copy of both the current record and the updated version to an audit log file 140. The IO manager module 132 next updates the accessed file 136, and if file indexes exist, the IO manager module 132 will write to a file index log 144. An asynchronous indexing module 146 reads the file and updates the modules.

If required, the IO manager module 132 will also write the data to the store and forward log file 142 as illustrated in FIG 3. As will be described more fully below, the store and forward modules transfer data from the minicomputer to the mainframe environment. The IO manager 132 updates the store and forward log 142 only when it receives a specific instruction to do so from its controlling transaction processing module 130.

The IO manager module as embodied in the present invention presents a number of distinct advantages. Because IO manager modules 132 perform the actual file access, using operating system commands, the applications programmer is freed from the need to be well-versed in the intricacies of file access for a particular operating system. Moreover, with only one IO manager module, an IO manager call is the same no matter what routine uses the IO manager or what file access request is required.

The IO manager's 132 use of an IO control table 134 permits security parameters to be easily placed on file access. With the use of tables, the security parameters can be easily changed, too. In addition, the audit log function guarantees that

there is a complete record of all file changes. Finally, the IO management system of the present invention permits flexibility for file design change. Should the need arise to use a different file system, the change can be implemented quickly -- by changing only the code for the IO manager master copy and possibly the IO control tables for the transaction processing modules. The code of each transacting processing module program need not be changed.

3. Store and Forward

A third distinct communication utility module of the transaction processor according to the present invention is store and forward. The basic function of store and forward is to take data from a globally accessed file on a mini-computer system 34 and transfer the data across a communication link to a database and program modules that reside on the mainframe 36. With the present invention implemented in the three-tiered hardware environment depicted in FIG 1, PC's 6 provide data input and local updating facilities and enable the user to access the larger computers for inquiries; mini-computers 4 provide immediate results for larger groups of data; and the mainframe 2 houses massive storage tables and program modules that perform calculations with large amounts of data. It is the store and forward modules 41, 42 of the present invention that handle the movement of data from mini to mainframe environments.

The basic information unit exchanged between hardware environments under the present invention is a bundle. Store and forward does not transfer

separate records. A bundle consists of the update activity corresponding to one logical unit of work from a workstation command or batch process.

The process flow of the store and forward modules is shown in FIG 6. Mini-computer resident transaction processing modules 150 and workstation resident front-end modules 152 can reference mainframe transaction processing modules using store and forward. A transaction processing module 150 using its IO manager 154 stores information in the mini-computer-resident store and forward log file 43. In the present invention, the store and forward log file 43 exists on a separate Stratus brand mini computer and is accessible to all transaction processing modules using the mini-computer-linking hardware 158 such as Stratus Strata-Link hardware.

Asynchronously, a mini-computer-resident store and forward sorting module 160 sorts through the store and forward log file 43 to gather bundles of information to send to mainframe ports 170. The sorting module 160 sorts transactions into different priority classes and stores them on separate logs 162, 164, 166 by priority.

A mini-computer-resident communication module 168 next sends a bundles of logged transactions to the mainframe. Using an IBM brand mainframe as an example, the data is sent to CICS operating system region of the mainframe.

Store and forward maintains a number of transmission lines using a bisyncronous protocol format such as an IBM Logical Unit 6.2 Protocol or

an bisyncronous IBM 3780 Protocol.

For each transmission line attached to the mainframe ports 170, a program module 172 monitors the transmission function. That program module 172 gathers complete messages from the mini-computer 168 workstation or PC-resident 152 modules. The monitoring modules 172 will write messages to communication ASCII format files 174 and notify the mini-computer or workstation resident communication module 168 of the message receipt.

During the transmission of information bundles, the mini-computer or workstation resident communication modules 168, 192 communicate with the mainframe-based modules 172. The mini-computer resident store and forward module computer 168 or workstation resident 152 module initiates the procedure; the mainframe module 172 controls it. For example, the mainframe module 172 instructs the mini-computer module 168 where in the log to re-start, in gathering a full message bundle and which steps to repeat.

Asynchronously, a mainframe resident store and forward controller module 176 reads the ASCII code file and invokes one or more translation modules 178 to translate the data from one file format to another, if necessary. For example, in a transmission of data from a Stratus brand mini-computer environment to an IBM mainframe computer environment, the data must be translated from ASCII character format to the EBCIDIC format that is used for file storage in IBM brand computers. Translated records are stored in an EBCIDIC format log file 184.

A group of files 180 known as "key files" are used in the handling of data on the mainframe. All static translation information resides in the key files. In addition, on-line updated information such as the date and time is maintained there, because every bundle that arrives from the mini-computer is time stamped. The key files also store any re-transmission information on a given bundle. The line monitoring modules 172 uses key file tables 180 to track the transmission of the information bundles between hardware environments.

To make the translation, store and forward translation modules 178 access a number of key files 180. A key file contains information, concerning the field structure for every mini-computer-based file. The translation modules utilize the key file information to map the mini-computer file bundles and locate the bundle fields that require translation. The translator modules 178 also use key file information to decipher specific fields. For example, in translating between ASCII and EBCDIC formats, a translator module 172 determines that the first five bytes of character contains information and must be translated, while the next four bytes represent a four word, binary number that needs no translation. The translator monitor modules then store all translated bundles in an EBCIDIC format log file 184.

The Store and forward modules completes their function by sending the data to massive database tables 186 maintained on the mainframe. Reference tables located in the key files 180 contain information to map the EBCIDIC file 184 record

information for the transaction to its appropriate place in the massive storage tables 44. An updater module 188 accesses the EBCIDIC file data 184 and "points" the information, using the key file mapping information, into the massive storage files 44. The actual "pointing" is performing by "pointing" modules 190 built to access a specific table in the massive storage area 44. Good data is available to any object with mainframe database access such as mainframe resident transaction processing modules 192 or users making database inquiries from workstations. Store and forward also employs a notification module 46 to alert other mainframe transaction processing modules 192 of the massive storage table 44 updates. Those transaction processing modules 192 will access the massive storage table 44 to obtain the information.

To perform the data translation between file formats such as ASCII and EBCIDIC, a user must specify, beforehand, the file structure for the massive storage table and the mini-computer resident file between which data bundles will be transferred. For purposes of an exemplary embodiment of the present invention, it is recommended that a one to one or one to many file relationship exist between the mini-computer files and the mainframe computer massive storage 44 tables.

C. Reference Databases

1. Database Descriptions

The present invention includes reference databases 76, 77 that comprise central files storing general

information used by transaction processing modules. For example, an implementation of the present invention for an investment institution might have the following general reference databases as shown in FIG 7; a floor broker master database 200; a producer master database 202; a trading accounts master database 204; a product master reference database 206; a customer accounts reference database 208; a firm price management database 210 and a figuration formula database 212. Using the example of the present invention, implemented in a three-tiered hardware environment, two exact copies of these databases are maintained, one in the mini-computer environment and one in the mainframe environment. (See FIG 3 at 76 and 77).

A unique database feature of the present invention is a group of product classification trees 214 that are created for use by different transaction processing modules from a product classification front-end module 216 that accesses data in the product master database 206. Other front-end modules 218 allows users to access database information directly.

The floor broker master database 200 keeps information on registered exchange floor brokers who trade securities for a firm. That database 200 enables a security trading firm to maintain such general information about the brokerage firms and their traders such as the firm's name, address and tax identification number. The floor broker master database 200 maintains flexible broker fee rate tables that apply to an exchange generally or to a specific broker or firm. Flat rates that apply to individual brokers or brokerage firms are also

maintained. The floor broker master database 200 contains data to calculate discounts that specialist brokers sometimes offer.

The producer master database 202 is a storehouse of data concerning all registered exchange producers who execute trades for the trading firm - salespeople, traders - anyone who must be registered to deal in securities through organizations such as NASD but who is not a floor broker. The producer master database 202 keeps data on producer sales pool affiliation, registration, and regulatory exam pass information.

The trading accounts master database 204 stores data on an investment firm's trading and bank accounts. Trading departments and desks, as well as individual traders are associated in the database with the firm's trading accounts. Reference tables are maintained in the database for trading account validation.

The product reference master database 206 maintains reference information associated with all the products purchased or sold by an investment firm. Domestic and international security products that comprise this file include but are not limited to equities, debt, options, futures, mortgage-backed, securities synthetics, and money markets. For foreign securities, international settlement calendars as well as country and currency of issue information is maintained for each product.

Associated with the product master database 206 is the product classification system (PCS) and the collection of product classification trees 214 that

PCS module 216 creates for general access by transaction processor modules 220.

The product classification system provides the ability to install, modify and determine product classification schemes for each security product listed in the product master database.

The product classification system (PCS) is a method of categorizing products according to product attributes. As embodied by the present invention, a PCS tree file 214 comprises a number of inverted tree hierarchy-tables and commonly accessible subroutines to traverse those trees and access the data in them.

The product master database 206, described above, contains different attributes for each product listed. For example, a security product, such as a bond, could have these attributes:

* U.S. (country of origin);
* coupon interest;
* base currency - U.S. Dollar;
* price; and
* Federal Government Security.

The various transaction processing modules of the present system need to classify the product differently according to its different attributes. For one system, the need might be to distinguish between foreign and United States country of origin securities:

Foreign Securities:	United States Securities
* Stock X (Canada);	* Stock A (EXXON);

* Gov't Bond (West Germany); * Gov't Bond (Fed. U.S.);

* Municipal (Hamburg); * Municipal (N.Y.C.);

Another system may require a classification of products that distinguishes between governments and municipals and other securities:

Government Securities:	Other:
* Gov't Bonds (Fed. U.S.)	*Stock A (EXXON)
* U.S. Municipal (N.Y.)	*Stock B
(foreign)	
* For. Municipal (Munich)	
* For. Bond (West Germany)	

A product classification tree 214, grouping products by country of original is shown in FIG 8. A process flow for the program modules that comprise PCS is depicted in FIG 9. Referring to FIG 9, an inverted tree construction module 300 allows users to specify the various formula relationships to build a tree via a workstation resident front-end module 308. These user specified rules are shown in FIG 8 at 252-276; they are the basic nodes to construct the tree. Identification codes for references to the product master database are the leaf nodes of the tree. (See 280-294). Traversing modules, FIG 9, at 302, permit a transaction processing module 304, such as the trade entry module described in FIG 3, to traverse a PCS tree and obtain the information on the classified products. With the product numbers found, the transaction processing modules access the product master database 306 for complete information on each product.

Many transaction processing modules of the present invention, such as the trade entry module and the firm inventory module, described in FIG 3 use one or more PCS trees to process data. Many transaction processing modules share PCS trees for common operations. All products in the product master database 206 are listed in every PCS tree. Where only certain product classifications are relevant, a not applicable, "N/A" field at the beginning of a node marks irrelevant branches, as shown in FIG 8 at 296.

With the product classification system as used in the present invention, there is no need to hard code product attribute classifications into the codes of transaction processing modules as is done currently.

The product classification system also supports on-line changes to the PCS trees. FIG 9 shows the process flow for an add, delete, or change to the product attributes.

Through the front-end, on-line module 308, a user can modify the product master database 306 -- either adding or deleting a product or changing a product attribute. Product master maintenance module 310 receives the input via the generic distribution mechanism module 38 and invokes a notification module 312 to notify the PCS module 314, and every feature system that uses PCS 304 of the database change. The generic distribution mechanism module 34 as described above (See FIG 4), performs the notification on the mini-computer, and on the mainframe, the store and forward module notification (See FIG 6) performs notification..

The PCS module receives notification and invokes either an add 316, delete 318, or modify 320 module to traverse every existing PCS tree and update the tree. Transaction processing modules 304, such as DIR 70 are responsible for reclassifying all transaction data that would be affected by a product classification change, as will be described below. The transaction processing modules 304 utilize the new PCS trees to make the changes.

The product classification system of the present system presents a flexible and efficient method for on-line product classification alterations. PCS eliminates the need to rely on product "type" codes often used in the past to classify securities. Those systems had a distinct disadvantage in that the product codes were necessarily written into the program's logic. When a new security product is added in those systems, or a characteristic is changed in one of these already existing products, the program code for the application had to be changed. With the system of the present invention, product codes are not written into the applications code. Changes required to implement a new product for altered business conditions are therefore easy to implement and do not require extensive reprogramming.

Referring again to FIG 7, the customer accounts reference database 208, contains reference data associated with a firm's customer accounts. Information is maintained to accommodate numerous delivery instructions, multiple salesperson coverage, security transfer instructions, trading authorizations and compliance papers. Data are maintained to denote whether an account is a parent

account or a sub-account of a particular parent. Examples of the categories of information include names and addresses, standing delivery instructions, institutional delivery information, telex confirms, financial profiles, trading authorizations, futures and options information, legal documentation information, credit limits, and broker database cross-references.

The firm price management database, 210, provides an integrated, globally accessible repository of all pricing information used by the transaction processing modules. The database also provides information for real-time collection and distribution of prices. Pricing information is kept in the currency denomination native to the security products being sold. The database stores the currency exchange information necessary for conversion. The database also contains a collection of security prices and currency exchange rates gathered from external data sources. Outside sources include Pricing services such as "J.J. Kerry", "EOM" "IOSI" and "CSJ" "EOM", "IOSI", "JJK" and "CSI". Internal pricing sources include input from the trade entry modules, and manual on-line price inputs. Price entries in the firm price database 210 are associated with entries in the product master database 202.

The figuration database 212 is a collection of subroutines to make common calculations. As the present invention is implemented for a securities trading firm, the figuration database 212 can include routines to calculate yields for fixed income, equity, future and option securities.

As implemented in the three-tiered environment of workstation 6, minicomputer 4 and, mainframe 6, (see FIG 1), the databases described above will exist in a centralized repository in the mainframe 77, and in addition, a duplicate copy 76 will be stored in the minicomputer environment (See FIG 3). The mainframe is the central repository for all transaction data used by the system. However, because transactions are processed by the quicker processing, fault-tolerant minicomputer, a working copy of all databases described above are kept in the mini-environment.

For purposes of an exemplary embodiment of the present invention, it is recommended that the IBM relational database sold under the trademark "DB2" be employed for the database on the mainframe. For purposes of an example embodiment of the invention, it is recommended that one or more Stratus brand fault tolerant mini-computers be employed to perform fault tolerant processing. On that mini-computer it is recommended that stratus operating system VOS files with indexed files be used to implement the database.

2. Front-End Database Related Features

As will be described below, the all programmed feature modules of the present invention access the general databases. However, the present invention also contains programmed modules to give a user direct on-line access and allow the user to create, update and view the databases, and, in addition, perform calculations on the database information.

The product master front end module (FIG 9, 308)

also provides a user inquiry facility. The product master reference database (FIG 9, 306) is referenced by presenting to the user a series of questions about a product he or she wishes to locate. The user is queried about the characteristics he or she seeks in the searched for security product. For example, the system can find the product a user requires by asking for its symbol, strike price, or expiration month. To access product master information, the product master front-end module (FIG 9, 308) invokes the product master traversing module (FIG 9, 302).

The product master front-end module (FIG 9, 308) provides a help facility to assist the user in searching the database for a security where a key is not known. The module 308 constructs a search key into the product master database 306 by type of product and returns those securities that best fit the supplied description.

3. Firm Price Management System

The firm price management system of the present invention provides the user with a front-end feature module (FIG 9, 218) to access the firm price management database (FIG 9, 210). As described above, the firm price management database is the depository of all pricing information used by the firm's computer applications. To access the firm price management database 210 the front-end module 218 comprises: an external and automatic price capture module 220, a trader price-marking module 222 and a yield/commission calculator 224.

The price capture module 220 maintains and updates

the security price and currency exchange database files from a variety of external data sources. Collection of prices is a two-step process. Prices are first gathered intra-day and at the end of the market day. Then the information is sorted and specific prices are selected for storage. Internal sources of prices from executed trades are also used to update the firm's price management database 210.

The trader price-marking module 222 related to the firm price management database 210 allows the user to manually enter a price for a security. The trader price-marking module 222 allows a trader to establish and enter a price for a selected security. The trade price marking module 222 permits a user to select a method of pricing, for example a treasury code or pricing by utilities to determine the price of a security.

The present invention also includes yield/commission front-end modules 224 that permit traders to use the figuration database routines 212 to calculate security yields using current price database information. The yield/commission calculator module 224 aids traders in arriving at pricing estimates before trades are executed. The modules can be used as a replacement to stand alone devices such as the "Monroe Bond Yield Calculator". By utilizing a group of centrally accessed databases, the present invention integrates the pricing function into a single transaction processing system. In addition firm traders can make pricing estimates with greater accuracy, because the pricings are computed using actual firm prices that are updated on-line.

D. Transaction Processing Modules

As depicted in FIG 3, the transaction processing modules of the present invention are programmed elements that perform the actual transaction data processing. Each transaction processing module is linked to the user front-end modules and other transaction processing modules through the generic distribution mechanism modules and the store and forward modules, as described above. File access for each feature module in the mini-computer environment is performed by a dedicated IO manager as described above. The communications network permits the integration of the functions and sharing of data between transaction processing modules.

1. Trade Entry Transaction Processing Modules

The prime task of the transaction processor is to track transactions entered into by an organization. A cornerstone function of the present invention is performed by the modules that receive input on newly executed trades. In the example implementation of the present invention for a securities trading organization, transactions are executed at customer account desks, at interfirm trading desks and, on market exchange floors. An exemplary embodiment of the transaction processor for a securities trading firm would incorporate the trade entry modules 48 as depicted in FIG 10.

The trade entry module 330, described below, will be the central entry point for all executed transactions. The executed trade files 50 created by the trade entry 330 module contains records that

represent the official "booking" of trades. The executed trade file 50 is also the master source of trade-related information for all subsequent transaction processing modules, such as the cash management system module 54 (CAMS) and the clearance module 52, as depicted in FIG 3. As the data fields from an example executed trade file in Appendix IV show, a great amount of data concerning a trade is stored in the executed trade files.

However, to supplement the accurate building of the central executed trade file, the present invention can include two additional transaction processing modules to capture trade information directly from floor trading and desk trading operations. Data collected by both a floor entry module 334 and a desk entry module 336 is matched against the executed trade file data 50 by a breaksheet processing module 338. The breaksheet processing module 338 processing will enable trade entry operators to quickly find and correct the inaccuracies of executed trade file.

i. Trade Entry Module

The trade entry feature module is the central entry point for all executed customer or firm security trades.

The method of the present invention for entering a trade is illustrated in FIG 11. Data concerning an executed trade is entered by a trade-entry operator 340. In the three-tiered environment, as depicted in FIG 1, entry operators enter data on a workstation 6. A workstation based trade entry front-end module 342 accepts the data from the

keyboard of the workstation and a type checking module 344 performs field and data-type checking. If the data is acceptable, the generic distribution mechanism 38, as described above, is invoked by the workstation based front-end module, 348. The interactive PC-based router module 40, a pier to pier communication routine described above, sends the data to the mini-computer-resident generic distribution mechanism 38, also described above. That router system sends the data to the trade-entry system queue 350.

The trade entry wake-up module 352 reads the data from the queue 350 and sends it to a validation module 354 for error-checking. The validation module 354 accesses data from the general reference databases 356 to validate the trade. For example the validation module 354 would check the product description against data from the product master database to determine if the product actually exists. The routine would also check trader data to determine if the trader was authorized to make the trade.

Trade net monies are next calculated for each trade. A figuration module 358 calculates -- principal, interest, discounts, commissions. For example, these calculated figures are summed to figure the net monies for the trade. The system can calculate trade net monies in four different currencies: according to base, notice, consolidated, and settlement difference. Currency conversion tables located in the general reference database 356 are used to make the calculations.

A trade entry derivation module 360 next performs

data derivations and population, patching information gaps with derived information and filling the data fields. For example a trade entry operator might enter "M" for the account of customer: Merrill Lynch. The derivation module 360 would use information from database such as the product master 202 to completely build the customer data field information, supplying "Merrill Lynch" and other relevant information concerning that account.

The general database information used by the trade entry systems is generally gathered by the system and stored in one or more trade entry extract files 357. The trade entry system database extract files are created in a trade extract builder batch process 359 that takes all general reference database file data 76 relevant to trade entry modules and writes it to indexed files. The extract files 357 provide speedier access to common data than would be referencing the larger general databases.

As described above, notification of updates to the general reference are sent to transaction processing modules (See FIG 9). The trade entry extract builder 359 receives a notification of general reference database updates. The extractor builder module 359 then accesses the general reference databases 76, reading the specific updated fields that are relevant to the trade entry transaction processing modules and updating the general reference extract files 357. The extract builder module 359 processes in background. The trade entry processing modules such as the validation 354, figuration 358 and derivation 360

modules receive all general reference data through the general reference extract files 357. The extract files are built to speed reference database access.

With the trade data validated, derived and figured, a unique trade transaction number is assigned, and in certain instances trades are split by quantity into one or more trades of smaller quantity by a process known as trade generation. A trade generator module 362 handles the process of breaking a larger transaction into smaller trades. For example, trades that expected to settle using a device known as "The Federal Wire Service" can only clear in denominations up to a certain dollar amount. Trades for securities having a dollar amount greater than the Federal Wire Service limit must be split into several trades of smaller denomination. The process flow for trade generation in the trade generation and trade number assignment module 362 is described more fully below.

Once the trade has been validated, figured, derived, and generated, it is "booked." The booking process entails writing the collected information into an intermediate log file 366, and returning a favorable acknowledgement message to the user. A trade booking module 364 performs the update to the intermediate log file 366, and a notification module 367 returns the acknowledgement message. Asynchronously, an updater module 368 reads the records kept in the intermediate log file 366 and copies the data into the executed trade files 50 and the store and forward log file 43. The executed trade file 50 is a central storage.

repository used by all mini computer-resident transaction processing modules needing data on newly booked trades. Associated with the executed trade files 50, are one or more index files 374 that permit quick access to all executed trade information. An index manager routine 376, initiated by the updater module 368, performs the index file 374 updates. A batch index log 375 contains the relative record number of the executed trade file record to index. The store and forward log file 43 is a storage area for data to be shipped to feature modules residing on the mainframe environment. An IO manager module 378, as described above in FIG 5, executes all file access. Appendix IV lists the data fields for exemplary executed trade files for a security trading firm.

The final step of trade entry is to notify other transaction processing modules of the newly booked trade. This task is performed using a notifier module 380 which creates messages to send to other modules via the generic distribution mechanism module 38.

The trade generator's process flow is depicted in FIG 11a. The trade generator module of FIG 11 at 362 is represented by two submodules. A determination module 380 makes an initial determination into trades of smaller quantity. To make this determination, the determination module 380 accesses product and settlement information from the general reference extract files 356. If the trade must split a trade generator module 384 is called. The generator module 384 loops, copying the data concerning the trade into smaller-sized

trades. Each smaller trade will be "booked" as before using the book trade module 364 that is described in FIG 11. Each small trade will receive a unique table identification number. The split trades are linked by identification number.

ii. Floor Entry Module

To satisfy customer trade obligations, a securities trading firm can purchase securities either in markets for regularly traded securities or in over-the-counter markets from dealers. The floor entry modules of the present invention receives input on all executed floor trades. The data reflects trades that have been executed on behalf of a securities trading firm in regulated markets such as the New York Stock Exchange. The data compiled by the floor entry module 334 is used to reconcile against data from the executed trade files.

The process flow for the floor entry modules is depicted in FIG 12. Data is gathered by a workstation-resident 6, front-end module 390, either online from user input 392, in batch from taped records of programmed trades 394, or other stored trade records. The generic distribution mechanism 38, described above, receives the data in the minicomputer environment 4 and routes it to the mini-computer queue 400 dedicated to the floor entry system.

From this point the floor entry module would process in a manner similar to the trade entry system described above. (See FIG 11). Trades records will be validated 402, figured 404, and populated 406, using data extracts file 408 created

from the general reference databases 76. The trade is next written to floor entry intermediate file 412 by a floor entry booking module 414. An updater module 416 using its IO manager module 418, will write the information to a floor entry trade file 420 and the store and forward log 43. That data will be reconciled against executed trade data during the breaksheet processing phase to be described below.

iii. Desk Entry Module

In addition to securities sold in general markets like the New York Stock Exchange, securities are also bought and sold in specialized over-the-counter markets. Trades executed on behalf of a security trading firm in over-the-counter markets are input into the transaction processing through the desk entry module 336 and the trade entry module 330. The process flow for entering a trade using the desk entry modules is depicted in FIG 13.

The desk entry modules in a manner similar to the trade entry system and the floor entry system as described in FIGS 11 and 12. Referring to Fig 13, a desk entry front-end module 430 receives trade data from a desk entry operator. The PC resident 6 module 430 sends the data to the minicomputer 4 environment for processing. The generic distribution mechanism 38 facilitates the communication and places the information in a mini computer environment memory queue 434 dedicated to a desk entry 438 wake-up module. The trade is then checked by a validation mode 436. A validation module 436, a derivative module 439 and a figuration module 440 all work to build a complete

desk-entry file record. Those record-building procedures are performed by accessing data extract files 442 created by an extract builder module 443 from the general reference databases 76. The trade is then written by a booking module 446 to a desk-trade log-file 448. In background, an updater module 450 writes the records from the intermediate log file 448 into indexed desk entry files 452. In addition, the updater module 450 writes the record to the store and forward log file 43. File access is performed using an IO manager 456 module. Entries in the desk entry files like those in the floor entry files will be used to reconcile against entries in the executed trade files.

iv. Breaksheet Processing Module

The function of the breaksheet processing module 338 is to match the records of the floor entry files and the desk entry files against entries in the executed trade files to find discrepancies in the executed trade files. Trade records are maintained when trades are executed either by floor traders or desk traders, the current practice is to write executed trade information on slips of paper and pass those slips to trade entry operators who will input the slip information on to some trade entry system. Problems with that current system include the fact that the slips are lost, or never created. Sometimes inaccurate information is written on the slips. The volume of trade execution and the speed at which trades are executed create the inaccuracies. However, there is no guarantee that the trades as input into the trade entry system are accurate.

The present invention alleviates the risk discrepancies by utilizing output of the floor entry module 334 and desk entry module 330 in conjunction with the output of the trade entry module 330. The processes of reconciliation of the floor entry 420 and desk entry 452 files with the executed trade files 50 is known as breaksheet processing.

FIG 14 depicts the process flow for breaksheet processing. In a background process a reconciliation gathering module 460 selects transaction records from the executed trade files 50 and potentially matching records from either the floor entry files 420 or the desk entry files 452. The reconciliation gathering module 460 performs file access using its copy of the IO manager module 468.

Potential matches are sent to a trade matching routine 470 that performs validation tests to insure that the gathered trades match. For example the matching routine will examine all trade generated split trades to match them against a single desk or floor file entry. In matching, the match trade module 470 accesses general product and broker data from the general reference databases 76. Unmatched trades from the executed trade file 50 and trades from the desk and floor entry files 420 and 452 that do not match against any executed trade file entry are listed in an unmatched trade file 474. A reporting module 476 creates a breaksheet report 478 for researching the unmatched trades from entries in the unmatched trade file 474.

v. Front-End Trade Inquiry Module

The present invention provides the user with a front-end capability to view trades as they have been booked.

The process flow for that trade inquiry function is described in FIG 15. With a front end module 480 resident on the workstation environment 6, a user can request data on a single trade or multiple trades. The generic distribution mechanism module 38, described above, routes the information request to the mini-computer based 4 inquiry modules.

A retrieval trade information module 484 first attempts to retrieve data on the requested trades. Using an IO manager module 486, the retrieve module 484 will search the executed trade files resident on minicomputer 50 and the mainframe database 490 for trade information. If trade information exists, it is presented to the user using a display window tailored to the specific type of security 492. A display module 493 sends information to the workstation to create the displays 492.

In addition to basic trade retrieval, a user has other options. A trade management review module 494, displays trades ba ed on user input search criteria and updates trade approval and time stamps for a given trade. A multiple trade search module 496 displays further trades based on the user input search criteria. In addition, the retrieve module 484 will display: all cancel and correct history for a single trade 498; all "give-up" history for a trade 500; all "when issue" trades related to a trade 502; and, for internally numbered trades, all

trades bearing the same trade sequence as the displayed trade 504. An option control module 506 loops presenting options 506 until the user exits.

2. Cash Management System Module

The cash management system module (CAMS) 54 depicted in FIG 3 comprises an integrated series of programmed element modules designed to provide a central, controlled environment for processing and recording cash receipts and disbursements. The CAMS modules perform timely reconciliation of bank cash flows with a securities trading firm's transaction records. The CAMS modules also provide to firm treasury officials current cash balance information and timely cash projections.

Implemented on a three-tiered hardware environment, the modules comprising the CAMS module of the present invention would reside in the mini-computer hardware environment 4.

CAMS module has three basic functions relating to the flow of cash within an organization. First, the CAMS module must record payables and receivables that are expected from business transactions. An example of this function occurs in the securities trading industry when a trade is booked - the expectation of a payable or a receivable must also be recorded. A second function is to record the receipt or payment of cash and reconcile that cash flow against the payable and receivable files. The third function is to provide users with an up-to-the minute record of the current cash balances in existing accounts and to show projected cash totals based on the

expected payable and receivables. Each of these functions is described in more detail below.

i. Payable and Receivable Management

CAMS receives data on payable and receivables from any system where there is the expectation of cash flow, such as from the trade entry modules 48 or the dividends interest and redeemable module (DIR) depicted in FIG 3. The method of creating payable and receivable records to mark expection of cash flow is shown in FIG 16.

A cash management system interface module 510 receives notification that the trade entry module 330 has just booked a trade and CAMS must generate a payable or receivable record. Notification of the creation of an executed trade file is sent from the trade entry module 330 to the CAMS interface module mini-computer queue 514, using the generic distribution mechanism 38, depicted in FIG 3. The CAMS interface module 510 receives the relative record number of the newly booked trade as it is written in the trade entry executed trade files 50. The CAMS interface module 510 calls a trade entry file accessor module 520 to retrieve information from the relevant executed trade file entry 50 that is pertinent to cash management, such as the amount of payment due or the name of the bank account that is to receive payment. The file accessor 520 is a module dedicated to locating data in the executed trade file 50. The fields in the executed trade file 50 used by the CAMS module are shown in Appendix V. The accessor module 520 retrieves the data and passes it to the CAMS interface module 510, which in turn, passes the information to a

CAMS log writing module 522. The CAMS log writing module 522 sends the data to a CAMS intermediate log file 524 and notifies initial CAMS processing module 526 by sending the relative log file record 524 to a queue 528 accessable by the initial CAMS processing module.

The initial CAMS processing module 526 asynchronously wakes to read the CAMS log file 524. The wake-up is triggered by an event such as the passing of time or the input of a number of new records to the initial CAMS processing module's queue 528. In implementing the present invention on a Stratus-brand mini-computer, the present invention would employ the Stratus-brand "wait event" function available as part of the Stratus operating system.

To determine where to begin retrieving records in the intermediate log file 524, the wake-up module 526 first retrieves the relative record number of the last record read in the log intermediate file 524, from a maintenance file 530. The initial CAMS processing module 526 next passes relative record numbers for all unprocessed log records to a CAMS data retrieving module 532.

The data retrieving module 532 retrieves the actual data from the CAMS log file 524 and determines which processor will handle the data. Many different systems send data to the CAMS intermediate log file 524. For each type of data, CAMS employs a different processing module to create payable and receivables.

A module for creating payable and receivable

records for a newly processed trade is shown in FIG 16 at 534. The payable and receivable creation module 534 first assembles the data and then writes it, via a CAMS IO manager module 536, to an integrated payable and receivable file (IPR) 56. The IPR file 56 contains a record for all payable and receivables expected throughout the system. A copy of the record is also placed on the store and forward log 43. The store and forward communication module, depicted in FIG 6, takes the data and sends it to mainframe environment transaction processing modules that also require CAMS module data.

With the data placed in the integrated payable and receivable file 56, the payable and receivable creation module 534 updates other files that are used for the bank totals and ledger keeping functions of CAMS.

First, the payable and receivable creation module 534 initiates an update to an integrated payable and receivable total files 540. The IPR total file 540 is used in making bank total projections, the third function of the cash management module. The totals are stored in different index files. To make the updates, the CAMS payable and receivable creation module 534 accesses information in one or more product classification trees 214, using a product classification traversing modules 216. The payable and receivable creation module 534 sends the information to be written by the CAMS IO manager 536 to a log file 548. Totals are also kept for each bank location. Bank location information is stored in the trading account master database 204. Asynchronously, an IPR total manager

module 552 takes the data from the log file 548 and using information stored in the trading account master database 204, updates a bank total file 540 and an index file 554, utilizing the CAMS IO manager 536.

Indexes are also maintained for the CAMS IPR file 56 under various keys. To maintain processing speed the index files are updated in background. The payable and receivable creation module 534 writes index information to a log file 558. An IPR item index manager 560 writes the indexing information to an index file 562. The IPR item index manager 560 uses the CAMS IO manager 536 and an asynchronous index updating module 566 to complete the task. To determine what was the last index updated from the log file 558, the IPR item index manager 560 maintains in a maintenance file 570 the relative record number of the last record taken from the log file 558. The CAMS IO manager 536 accesses the maintenance log 570 for the IPR item index manager 560.

Finally, the creation of integrated payables and receivables creates a need to update the general ledger interface module depicted above in FIG 3. The payable and receivable creation module 534 sends transaction data to the general ledger interface module 72, that will be described more fully below.

The payable and receivable creation module 534 acknowledges successful processing of the booked trade data by updating the CAMS intermediate log 524 and a "successfully processed" file 574. Notification is then sent to the trade entry module

330 on the CAMS processing success.

The CAMS modules comprise a number of checks to insure that data is processed accurately. When the cash management modules are initially notified of incoming payable and receivables, the CAMS initial processing module 510 first reads the CAMS intermediate log file 524 to see if the executed trade record to be processed has previously been added. Even if the new record has already been added, the CAMS initial processing module 510 will still call the execute trade file accessor module 520 to add the record to the CAMS intermediate log file 524. However, the record will be marked to show that it is a duplicate copy of the existing record. This method is used to protect the integrity of the system and insure that only one record is processed.

Also, before an actual processing module such as the payable and receivable module 534 is invoked, the CAMS retrieving module 532 first calls a checking module 576 to parce through the "successfully processed record" file 574 and check that the record to be processed has not been processed previously. If that record or its double has been processed, the data retrieving module 532 will not invoke any of the CAMS processing modules, such as the payable and receivable creation module 534 and processing will terminate.

ii. Recording Cash Flow

The second function of the CAMS is to record the flow of cash from the bank accounts and to reconcile that cash flow against the IPR file 56.

Data for the flow of cash is input to the system from a number of source applications. Data can also be input manually. This method is used when the firm receives a physical check. However, cash is mostly transferred through interbank wire transfers. CAMS receives wire transfer information from tie in services with banks. The wire information is received directly or it is received indirectly through updates from other transaction processing modules such as the clearance module 52 as depicted in FIG 3.

The CAMS cash flow process is described in FIG 16a. Much of the initial processing of the cash flow is exactly the same as the processing of a payable or receivable record modules as depicted in FIG 3. Notification that money for a trade has exchanged is received by the log writing module 522. A workstation front end module 582 accepts data on physical checks accessed or sent. The clearance module 52 sends data on wire transfers of cash. Input is sent to the CAMS log writing module 522 by the generic distribution mechanism 38. The CAMS log writing module 522 writes the information into the CAMS intermediate log file 524. The CAMS initial processing module 526 is awakened at the happening of an event or the passage of time. The module 526 sends the relative record numbers of the new records to the CAMS data retrieving module 532. Asynchronously, the CAMS data retrieving module 532 reads the data from the log file 524 and invokes the CAMS checking module 576 which determines if the record has already been processed. The CAMS checking module 576 reads the "successfully processed record" file 574 to perform the validation. The CAMS initial processing module 532

determines that the data concerns a cash flow and sends the data to a cash clearance module 580.

The cash clearance module 580 performs a number of processing steps. First, the cash clearance module 580 matches the cash movement data against a corresponding record from the integrated payable and receivable file 56. The payable or receivable file record will be updated with the cash flow information. The record in the IPR file 56 will reflect the sum still outstanding.

In addition to updating the IPR file 56, the cash clearance module 580 also updates a number of other files. Record of the movement is placed in the store and forward log 43 to be moved via the store and forward module 41, 42 to the transaction processing modules residing on the mainframe. Second, the cash movement is posted to a cash activity file 582 that provides a record of all movement of cash within between accounts controlled by an organization.

Third, the cash clearance module 580 creates a cross-reference for each record in the cash activity file 582, matching it's record against one or more file record that detail the nature of the transaction. The relative record number from the cash activity file 582 is matched with a corresponding relative record number from the IPR file 56. The cross-reference is kept in a CAMS cross-reference file 584. Details for all cash activity file records 582 can be located using this cross-reference method. The file access of the cash clearance module 580 is initiated by the CAMS IO manager 536.

When the receipt of cash update comes to CAMS from another transaction processing module, such as the clearance module 52 depicted in FIG 3, the details of the cash receipt have already been stored by the feeding system. In these cases, CAMS will not create a record in the cash activity file 582. Instead cash clearance module 580 expects to match a provided relative record number to a detail file of the feeding transaction processing module (e.g. clearance 52) with the relative record number of the IPR update placed in the cross-reference file 584.

However, as described above, cash movement can be entered manually, through a front-end input module 582, where an operator keying into CAMS inputs the details of a received check. In that case, cash movement is posted to the cash activity file 582 in the same manner as if the cash movement was reported by the clearance module 52. But, there will be no system provided detail file record to cross-reference with the posted cash activity file record. In cases of manual input, the cash clearance module 580 will create a CAMS activity file 582 record which can be cross-referenced against the CAMS IPR file 56 record.

Once the main file updating activities are complete, the cash clearance module 580 next initiates updates to the bank totals files and the general ledger. In addition the module performs cross-index updating for the cash activity and integrated payable and receivable files.

First the cash clearance module 580 accesses product classification system files 214, utilizing

the product classification system modules 216. This information is used for indexing updates. In addition, the cash clearance module 580 accesses information in the bank location file 204.

The cash clearance module 580 initiates updates to the payable/receivable totals files 540, by writing the information into a log file 548. The asychronous processing IPR total manager 552 reads the data from the log and updates the IPR totals file 540.

The cash clearance module 580 updates information on the bank account balances, writing information to a log file 588. Asynchronously, a location account balance manager module 590 reads the log file 580 and writes the information to a location balance file 592, using the CAMS IO manager 536. To track the update progress, the location balance manager module 590 records the relative record number of all log file records accessed in a log file 596.

The cash clearance manager 580 next updates the keyed record file indexes for both the integrated payable and receivable file 56 and the cash activity file 582. The information is written to an intermediate log file 591. The intermediate log file 591 is asychronously read by a cash item index manager module 595. The cash item index manager 595 obtains the location for the next index updates in an index file maintenance log 597. That cash item index manager 595 then passes the relative record number of the update and the index update data to an index update module 598. The index module 598 writes the IPR index file record in the

actual index file 596 using via IO manager 597 and returns to 595 the relative record number of the next free index file record in the file 596. The cash item index manager 595 places that update in the maintenance file 597. File access for the indexing procedure described is performed utilizing the CAMS IO manager module 536.

Finally, as described above in FIG 11, CAMS will post the cash movement data to the general ledger module 572. And as before, the success of the transaction processing is maintained in the cash management system log 524 and the "successfully processed" file 574.

iii. Account Totals and Cash Projections

The third function of the cash management system is to display current bank account totals and to project future cash totals for the end-of-day and next-day. Those functions of the CAMS system allow fund managers to make funding decisions with greater accuracy.

The bank position and forecasting system is illustrated by FIG 16b. An officer authorized to handle fund management can access the data in the IPR total files 540, the IPR item index file 562, and the bank account totals file 592. Those files provide the user with the current bank account totals. A cash position and forecasting module 595 accesses those files, using the CAMS file manager modules 552, 560, 590 and the CAMS IO manager 536. The next day and end of day projections are computed by examining the CAMS IPR file 56 for receipts that will become due. In addition, the

cash activity file 582 and the cash activity cross-reference files 584, provide factual details concerning the payable and receivables records in the IPR files 538.

3. Position and Balance Module

The position and balance (P&B) module 64, and the P&B files 62 of the present invention provide a centralized, integrated database for all firm position data. Using the example of a security trading organization, position data relates to all securities owned by the customers or firms that are maintained by the firm at various security depository locations. Position and balance files also maintain information on the status of the positions -- for example indicating which securities are available for the firm's use in collateralizing a loan. The combination of the entity executing the transaction, product involved in the transaction, account on whose behalf the transaction was executed and position of the product comprise the definition of a security position. Assume for example that a customer purchased and paid for 100,000 shares of IBM common stock, through a firm's New York office, where the stock is currently held at its vault for safekeeping. Position and balance files record that customer's position in IBM as well as the status and location of the securities by entity within the firm.

Position codes are indicators of the type of position maintained by a given record in a position and balance table. Appendix VI contains a listing of position code examples for the present invention

as implemented for a securities trading organization. Position codes can be used for different purposes depending on their use in the P&B tables as shown by the chart in Appendix VII. For example in the P&B location files 606, 612 position codes such as "BOX", "FREE", "MXRP" and "SFK" indicate actual physical locations of security positions while "F/R" (filed to receive), "F/D" (failed to deliver") indicate an actual position in the securities, but do not reveal the physical whereabouts of the securities. Those position codes only give indication of the actual status of the trade against the contra-party. The above position codes (BOX, FREE, SFK, F/D, F/R) are all "True" position codes. A true position code gives some indication of the actual status or physical location relevant to the trade.

Position codes can also be used to indicate memo positions. In the present invention, two types of position codes are associated with customer positions: a "true" position and a "memo" position. A memo position indicates how customer security positions (held in streetside name) have been used by the firm. Memo positions such as "FREE" (free for firm use), "SEG" (segregated from firm use), and "SFK" (safekeeping in firm vault) all indicate how customer positions are utilized by the firm.

i. Position and Balance Tables

As implemented for a securities trading organization, the position and balance files 62 comprise seven different files, as depicted in FIG 17. For purposes of a preferred embodiment of the present invention where the transaction processor

is implemented in a three-tiered hardware environment of minicomputers, microcomputers and mainframe, all product positions are maintained separately by trade date and settlement date.

A set of trade date position tables 602, 604 and 606 contain position data on executed transactions whose settlement date does not yet equal the current date.

By trade date, firm account trade date file 604 contains information on executed transactions, as of trade date (i.e. when the trade is executed), by firm accounts. A customer account trade date file 602 contains trade date data on security positions by customer account.

A location trade date file 618 contains information on executed transactions as of trade date as to streetside location of the products (e.g. securities) involved in the transactions.

A balancing function is inherent in the position and balance module through the netting of the customer and firm account positions on the one hand, and the location positions on the other.

Using the example of a securities trading firm, the firm and customer account positions represent account ownership of the securities while the actual location of the securities represented by those firm and customer account positions are recorded in the location tables. Security location can be in many "street side" locations established by the firm, such as the firm vault or the DTC (Depository Trust Company). Thus, as product

ownership and security location define a security position, account ownership balances against security location. Customer and firm account positions, by trade date (and settlement date) should balance against location account position (by trade date and settlement date). Because different modules of the transaction processor of the present invention supply data to update different P&B tables (i.e., account-side/location-side, as will be described) the table structure of the position and balance module 64 of the present invention, presents an innovative way to track transactions information discrepancies. Where account-side entries fail to match location-side entries the P&B module 64 creates "dated-break" records as will be described more fully below.

Referring to the tables in FIG 17, executed transaction data is also maintained by settlement date in balancing account-side and location-side data tables. A customer account settlement date table 608 maintains settlement date transaction data by customer account. A firm account settlement date table 610 maintains settlement date transaction data by firm account. Those firm and customer settlement date table entries can be balanced against entries in a location settlement date table 612. As will be described more fully below, a product account memo table 614 contains entries that link, by settlement date, customer memo positions to physical locations.

FIG 18a-b depicts possible record entries in a typical settlement date position and balance file for the present invention, as implemented for a securities trading organization. FIG. 18a depicts

typical balancing entries on the settlement date firm account table 610 and the settlement date location table 612. Entry 610a shows that the trading firm holds $5,000,000 worth of United States Treasury Bills in its account "TRD-ACCT-A." In the present example, the key to the firm settlement date position file 610 is a company (the entity which executed the transaction, a product (T-Bills), and an account. In addition to the key information, a typical firm account record (trade date or settlement date) would include the quantity of securities held.

The firm account table records (both trade date and settlement date) carry no position code. Only ownership at the T-Bills and the account (TRD-ACCT-A) is position information indicated by record 610a.

The locations account table entries 612 should balance against security position held by the firm in 612 its firm account 610. Typical entries 612 and 612 to the settlement date location table show that $5,000,000 in United States T-Bills, dated 1/18, are held in two location accounts at "IRV" and "MHT", and they are in "FREE" position, ready for firm use. The keys to the location file are company (firm entity which executed the trade), contra party/physical location account (e.g., IRV, MHT,), Merril position code and product. In addition to the identifying keys, the location account table 612 will contain other information such as product quantity.

The balancing of the settlement date firm account-side and location-side record entries is indicated

by the arrows in FIG 18. Account and location records are matched by company, product position and quantity. A unique feature of the present invention its multi-entity balancing capability. Using the company key, account and location records can be balanced by the entity that performed the transaction such as a trading firm's New York or London office.

Where account entries fail to match corresponding location entries, the position and balance module 64 will create a "break record" entry in the location file (in both trade date and settlement date cases). The break record would contain a "BRK" position code and the date of the misbalance. Dating record breaks is advantageous because data discrepancies do not proceed to the next day unmarked. The dating permits a stock researcher to locate the cause of the break with better efficiency.

FIG 18b shows typical balancing table record entries in the P&B customer settlement date table 608, the location settlement date table 612, and the product account memo table 614. The entries in the customer account settlement date table 608a and 608b show the holdings of customer A by account: 1,500 shares of EXXON allocated to a margin account 608a and 3,000 shares of EXXON stock allocated to a cash account 608b. The keys in the customer account tables (trade date and settlement date) are company, product, and account (sub-account). A quantity code is also indicated, but no position code. In the example, sub-type on the account-side shows only that the customer has taken ownership of the securities in its margin and cash accounts.

The settlement date location table entries 612c and 612d depict street side location positions in EXXON stock. 4,500 EXXON shares are held in a DTC street side account. However, two different position codes apply to the street side holdings, in this example, in accordance with securities industry trading rules. 1,000 shares are "FREE" for firm use (612c). While 3,500 are not available for firm use, as they have been segregated "SEG" to fulfill regulatory requirements. As a matter of securities industries practice, when securities are purchased on margin for a customer account, but in the firm name, a certain portion of the securities held can be used by the firm for loan collateral and other purposes. However, a portion of these securities, by regulation, must be held to cover the customer's margin buy. The "SEG" code is used in location table record 612c to show the status of the 3,500 shares of the EXXON stock in the street side "DTC" location.

The customer account and location tables in FIG 18b balance as indicated by the arrows. However, the present invention also comprises customer account position memo file entries 614a-c to further link settlement date customer account and location data, beyond balancing offsetting record entries.

In the present invention two types of positions are associated with customer positions: a "true" position and a "memo" position. Each record in the customer account table 608 (e.g. 608a and 608b) contains the "true" position. In the example of FIG 18b the true position is that customer A has taken ownership of 4,500 shares of EXXON, allocated by 1,500 to a margin account and 3,000 to a cash

account. The present invention also associates internal "memo" positions to the customer account holdings. The memo position relates the customer holdings to a physical location position code (e.g. TRANF, SFK, REORG). For example, securities purchased by a customer with cash cannot be used by the firm for loans and other purposes. However a certain portion of securities purchased by a customer margin can be used by a firm for loans and other purposes. The rest must be segregated. Thus, apart from the true position codes, memo position indicate how the firm may use customer securities.

The description key for records in the customer account memo table 614 (e.g. 614a, 614b or 614c) is a combination of company, customer, account (and subaccount), position code and associated account field. The important field on memo table records is the associated account field. The associated account field provides the link between memo 614 location 612 position records, because the associated account field in the memo table 614 contains corresponding entries from the account field in the location table 612. Using the memo position table 614 with the associated account field provides a flexible way to match customer account record entries with location table entries.

ii. Input to the Tables

Referring to FIG 17, the P&B module 64 comprises a position and balance manager module 600 (P&B manager) a P&B trade processor module 616; a P&B balance activity module 624; a P&B trade reference table 618; a P&B transaction activity table 620;

and a P&B activity table 622. It is the P&B balance activity module 624 that performs the "break record" balancing of account-side and location-side records by trade date and settlement date as described above. The P&B balance activity module, performs in batch at the end of the day while the P&B tables are updated by other components of the P&B module on-line during the business day.

All updates to the P&B tables 62 are made by the position and balance manager module 600. The P&B manager module 600 receives data updates initiated by many different transaction processing modules (e.g. trade entry modules 48), and makes the P&B file updates based on the type of transaction data entered. Because the many different modules handle different aspects of the transaction process and all feed data to P&B module 62, the P&B tables are a true central storage place for transaction position data.

Following the example of the present invention as implemented for a securities trading firm, the trade entry modules 48 provide data on newly executed trades, "as of" trades, and cancelled or corrected trades. As will be further described below, the P&B trade processor modules 616 first receives raw trade entry data and, after processing it, sends it to the P&B manager 600 to create the appropriate P&B table 62 updates. The P&B module 64 processes executed trade data on customer account transactions as it is sent from the executed trade modules 48 - on-line during the trading day. For customer trades having a settlement date in future of a trade date, the P&B

manager module 600 updates the trade date, customer 602, and trade date location tables 606 as is needed. For customer "as of" trades, cancel and corrected trades, and cash trades (which settle on the date the trade is executed), the P&B manager module 600 creates appropriate updates the customer account 602 and 608 location 606 and 612 and customer account memo table 614 by trade date and settlement date.

Transaction information concerning firm accounts is received from the trade entry modules 48 by the firm inventory module 66. It is the firm inventory module 66 that forwards firm account information to the P&B manager module 625. Based on transaction data sent by the firm inventory module 66, the P&B manager module 625 will update the appropriate firm account table 604 and 610 and location table 606 and 612 by trade date or settlement date or both (in the case of "as of" cash, and cancel or correct transactions).

The clearance module 52, as will be described in detail below, tracks and records all settlement activity related to transactions. In a batch process, the clearance module 52 provides the P&B module 64 with "settlement date set-up" information for all executed transactions that are due to settle during the next trading day. The P&B manager module 600 uses the transaction information provided by the clearance module 52 to remove customer 602, and location 606 table record entries by trade date and establish customer 608, memo 614, and location 612 positions by settlement date. (The firm inventory module 66, described below, provides "settlement date set up" input for the P&B

firm account files 604, 610). In addition, the clearance module 52 sends to the P&B module 64 on-line, during the trading day, transaction information of security receipts and deliveries. The P&B manager module 600 processes these events as they happen to update settlement date location position codes 600.

In a batch process, the dividends, interest and redeemables (DIR) module 70, as will be described below, sends transaction position information concerning stock splits. In batch process, the P&B manager module 600 updates the appropriate customer (602 and 606), firm (604 and 610) and location (606 and 612) tables based on the entitlement information sent.

The customer account module 68 sends to the P&B module 64 transaction information on the free-receipt or delivery of customer account stock and other location changes to customer account stock.

FIG 18c-d depicts typical P&B table 62 updates made on line, based on transaction information provided by the clearance 52 and customer account 68 modules.

FIG 18c depicts three transaction records sent by the clearance module 52 to the P&B module 64, during batch "settlement date set-up" processing. Record 630 depicts a firm sell to customer A of 1,500 IBM shares that was purchased on a margin account. Record 634 depicts a firm sell to customer A of 3,000 IBM shares, purchased with customer A's cash account. Record 632 depicts a firm buy of 4,500 IBM shares, presumably to cover

the customer A account transactions, as all transaction are to settle on the same day. Attached with each record is a transaction code sent by the clearance module 52.

Based on the transaction code, the P&B manager module will create the following updates to the settlement date customer account 608, product account memo position 614, and location 612 tables: using record 630 and 634 the P&B manager module 600 places a record in the settlement date P&B customer table 608c-d and the product account memo position file 614e-f indicating the ownership of 1,500 IMB shares in customer A's margin account and 3,000 IBM shares to customer A's cash account. P&B manager module 600 uses record 632 to create an entry in the settlement date location table 612e.

The entries made in the P&B tables 62 and the positions used for those entries, are determined by the transaction code entry on each record fed to the P&B manager module 600. A single transaction input can cause the P&B manager module 600 to make many P&B table 62 updates. The P&B manager module 600 uses the transaction code to access a P&B activity table 622, to determine the P&B table updates. Associated with transaction codes in the P&B activity 622 are indicators of the P&B table updates that need to be completed and the relevant position codes.

Notice that in this example as of the night before settlement, date the position codes on the customer account memo tables indicate that customer A's IBM stock are free for firm use on the eve of the settlement date while the true location position

entry indicates that the securities have not yet been received (failed to be received "F/R"). That position code configuration is a normal implementation of a securities industry practice where legal title is taken to securities as of settlement date regardless of whether the securities are actually received. There is no associated memo position for a "F/R" position, because the "F/R" position does not indicate a physical location.

FIG 18d depicts further P&B Table 62 updating input that arrives on-line from the clearance module 52 during the next business day, and input that arrives form the customer account module 68 at the end of the next business day.

As securities set for settlement clearance are actually received or delivered, the clearance module 52 sends records such as record 636. Record 636 indicates that 4,500 IBM shares were received as planned from "MERRILL", and they are located (either physically or electronically) at a firm account at the Depository Trust Corporation (DTC). Using that information and the transaction code carried on the clearance input 636 the P&B manager module 600 adds to the settlement date location file 612 record 612f, cancelling the previous F/R record for 4,500 IBM shares 612e. In addition, a new record 612g is added showing the stock receipt and its new location at DTC. The position indicator, "FREE", shows they are available for firm use. Again, there is no associated account position for the "FREE" position, because it does not indicate a physical location.

In a batch process, described more fully below, the customer accounts module 68, determines, based on securities industry practice rules, the amounts of customer account securities that must be segregated and therefore cannot be used for firm purposes such as loans. That transaction information (records 638, 640) is sent to the P&B module 64 to update the P&B table 62.

In the example of FIG 18d, record 640 indicates that all of customer A's cash purchase of IBM stock must be segregated from the firm usable securities. Using the transaction code, the P&B manager module 600 creates entries 614i and to cancel the "FREE" memo position entry 614f and also add record 614j showing that 3,000 IBM securities have been segregated (SEG) from the associated account DTC. P&B manager module 600 also creates similar updates to the location table 612, offsetting the "FREE" position record 612g with free record 612i and adding SEG record 612h. The SEG position code, as used in the location tables, is indicative of a physical location, thus the associated account "DTC" is placed in the memo entries, linking the memo and location entries.

The margin module 64 also sent record 638, indicating that 500 of the 1,500 IBM shares in customer A's margin account must be segregated from firm use. Using the transaction code, the P&B manager 625 creates updates to the customer memo file 622. Record 614g offsets 500 IBM shares from the "FREE" position record 614e. Record 614h indicates that 500 shares of IBM shares have been placed in SEG at the DTC account.

The P&B manager 600 also updates the location table 612, using information from record 638 update record 612k offsets 500 "FREE" EXXON shares from the 4,500 shares indicated by record 612g. In addition, entry 612j indicates that 500 shares of EXXON stock in the DTC stock have been segregated.

iii. P&B Manager Module Process Flow

Referring again to FIG 17, that figure illustrates the overall system flow of the P&B module 64. As discussed above, different transaction processing modules (i.e. trade entry modules 48, clearance module 52, firm inventory module 66, customer accounts module 68 and DIR module 70) send different transaction data to the P&B module 64. Each different type of transaction data sent to the P&B module 64 will cause one or more position activity updates to the P&B file, as was shown in FIGS 18c-d.

To send data to the P&B module 64 each feeding module sends with the transaction, a transaction code, as was seen for example on records 632, 634 and 636 in FIG 18b.

Transaction codes are table driven for trade related processing in the trade entry modules 48, clearance 52 and firm inventory 66 modules in the present invention. The codes are maintained in a trade reference table 603. Based on the different facts of the transaction (e.g. firm or customer transaction, Buy or sell), each module accessing the trade reference table 603 (i.e. clearance module 32, firm inventory (during settlement date setup) 66, the P&B trade processor (for the trade

entry module 48)) will forward to the P&B manager 600 its transaction data together with the transaction code located in the trade reference table 603. For non-trade related transaction input such as that from the customer account 68 and DIR 70 modules, there are so few codes needed to be maintained that they can be more efficiently maintained by not incorporating them into a table.

The P&B manager 600, using the data and the transaction code, creates from one to many position activity updates to the P&B files 62 depending on the transaction code. To determine the appropriate activity updates, the P&B manager module 600 uses the transaction code to reference the P&B activity table 622. The P&B activity table 622 lists the appropriate P&B activity updates and corresponding position codes for each transaction code entry. Using the data received and the activity references, the P&B manager 600 creates activity records to update the P&B tables 64.

As an audit trail, those records are time stamped and stored in a P&B transaction activity table 620. Generally, when the P&B manager 600 makes the P&B table entries 62 it also accesses the P&B transaction table 620, marking each update as completed, and return acknowledgement to the feeding modules such as the trade modules 48 and the clearance module 52. However, variations of this procedure exist as will be described below.

For purposes of a preferred embodiment of the invention components of P&B module would exist in both the minicomputer and mainframe computer environments. (See 3 and 36, FIG 3). The process

flow for such preferred implementation is depicted in FIGS 19a-b.

FIG 19a depicts the P&B module process flow where transaction processing modules, (such as the trade entry modules 48, and firm inventory 66), feed transaction data to the mainframe resident P&B module 64.

The trade entry modules 48 notifies the P&B system to the mainframe environment 36 by the store and forward system 43 and 41. The trade entry modules 48 write transaction data to the store and forward log 43 and notifies the (minicomputer resident) 34 store and forward module 42 using the notifier module 380 as described above. The mainframe resident store and forward module 41 receives the trade data, writes to massive trade entry storage table 44, and, using the store and forward notification module 46, notifies the mainframe environment modules, firm inventory 66, and the P&B trade processor module 616 of the massive storage table reference to the new data.

If the transaction data involves customer account transactions the P&B trade processor module 616 (like clearance (for setup) 52, firm inventory (setup) 66), will take the data and invoke a P&B trade reference table access module 704 to reference the appropriate transaction code from the trade reference table 618. The other mainframe environment 36 transaction processing modules (DIR 70 and margins 68) must know the transaction codes associated with the business event.

Once the transaction code is returned, the data and

code is sent to the P&B manager module 600 to build the appropriate activity records and update the P&B tables 62.

The P&B manager module comprises a number of sub-modules to obtain the activity data based on the transaction code. A P&B sub-manager module 710 receives transaction data and the transaction code and forwards the code to a format P&B activity module 712.

That format module 712 sends the information to an activity and position code accessor module 714 ("accessor module"). The accessor module 714 uses the P&B activity table 622 to determine what P&B table updates should be completed based on the input information.

Appendix VII contains examples of position code table entries that are used in creating different activity updates. The accessor module 714 uses account sub-code (01, 02, etc.) that has been sent from the input to obtain a position code for all customer trades. The accessor module 714 accomplishes its references to the P&B activity and position table 622, using a table access module 720 designed to traverse the activity and position table 622. The accessor module 714 formats the transaction activity record and returns the records to the format P&B activity module 712.

The format routine 712 next sends a request to time stamp the P&B table activity updates to a P&B transaction time stamp routine 724.

The time stamp routine 724 returns a current time,

an environment indicator number, and a sequence number for all activity records that will be created. The environment indicator shows the origin of the data that created the P&B table activity updates. Each update record to be created will also carry a sequence number assigned by the build transaction number 724. The combination of a transaction number and a sequence number makes each update unique. The format routine 717 returns a list of all updates to be created and their unique ID numbers to the main P&B sub-manager 710.

The P&B manager 600 also comprises a number of sub modules to create the activity updates and write them to the P&B tables 62.

The P&B sub-manager 710 sends the set up data to an update P&B file module 726. The update P&B file module 726 creates the P&B activity updates and sends these records to the appropriate P&B tables such as the trade date or settlement date customer account files (612, 616). Each file has an access module 732 to complete the actual updating.

If the update is successful, the update module 726 sends the activity record with a valid return code to an update transaction activity log module 734. The P&B transaction activity log 620 tracks all valid P&B database updates.

If the update P&B files modules encounters an invalid return code, an error code and file name is sent to the update module 726 and the update transaction activity log file module 734 returns the record to the P&B sub-manage module 710, which writes the error record to the transaction activity

table 620. An error code is also returned to the P&B sub-manager module 710 or then to the mainframe environment feeding modules (i.e. firm inventory 66, DIR 70, customer accounts 68, or P&B trade processor 601). The feeding modules internally handle invalid return codes and will resend the trade data. A record with an invalid error code is not forwarded to the P&B transaction activity file 620. A process input module 738 tracks all file access errors in an error report file 740.

The update routine 726 repeats similar steps for each P&B table 62 update that is to be created.

When all activity records are successfully written to a P&B and activity file, a valid return code is sent by the P&B sub-manager module 710 to the mainframe feeding modules.

FIG 19b depicts the processing flow for transaction related data processed in the minicomputer environment 34.

A transaction processing module in the minicomputer environment 32 such as the clearance module 52 accesses a minicomputer resident copy of the reference table 618 and sends transaction code and related data to a minicomputer resident P&B module 65. The P&B module 65 comprises a number of sub-modules to create the activity updates. A minicomputer-resident P&B sub-manager module 775 sends all non-trade information to a minicomputer-based edit checking module 774. The edit checking module 774 uses general reference database information from the customer account reference database 206, the product master reference database

204, and product classification trees 214. (See FIG 7). Database access modules 782, 784 perform the database traversals. The edit checking module 774 validates account number and product number and checks for required fields. If an invalid code is returned, the minicomputer resident P&B sub-manager module 775 returns the code to the feeding system and processing terminates. If the module returns a valid return code, processing continues, and P&B sub-manager module 775 sends the P&B transaction code and trade data to a minicomputer resident, format activity module 772.

The minicomputer resident format activity module 772 sends the transaction code and input data information to an activity and position code accessor module 776 ("accessor module"). The access or module 776 uses the transaction code to access a minicomputer-resident P&B activity table 622 and determine the P&B table updates that must be created. The activity and position code accessor module 776 uses the account sub-type (01, 02, etc.) carried on the trade to obtain the appropriate position code for customer trade data. The minicomputer-resident activity and post accessor module 776 performs the table accesses 600 using a table access module 782.

The format P&B activity module 772 also sends a time stamp request to a minicomputer-resident P&B time stamp module 784. The time start module creates a number that will be assigned to each of the P&B activity updates.

The format module 772 creates the P&B data update records and returns all records to the P&B sub-

manager module 775. The minicomputer resident P&B sub-manager 775 writes all transaction activity records to a minicomputer resident P&B activity file 620 and minicomputer-resident store and forward log 43. The P&B sub-manager module 775 then returns a successful update return code to the transaction processing module such as clearance 52.

The store and forward module 42 sends the activities to the mainframe environment store and forward module 41, which writes the minicomputer-resident log records to a mainframe P&B transaction activity table 620, and invokes the store and forward notifier module 46 to inform the mainframe resident P&B manager module 600 of P&B activity updates that have been generated on the minicomputer. Notice that in FIG 17a as records are processed in the mainframe environment, activity records are stored in the transaction activity table 620 -- as the P&B tables are updated -- with their validity codes already indicated. In the present example of FIG 19b, where activity records come initially from the minicomputer environment, they are immediately placed in the transaction activity table 620, without their validity codes indicated and before they are written to the P&B tables 62. The P&B sub-manager module 710 retrieves the corresponding records from the P&B activity table 605. The P&B sub-manager 710 records and forwards the updates to the P&B update module 726. The update module 726 sends update records to the appropriate P&B table (e.g., the firm account settlement date table 610) using one of the access modules 732.

If a valid return code is returned by the update

module 726, the P&B sub-manager 710 returns to the transaction table 620 and updates each activity recorded as validly received.

If an invalid return code is encountered by the table accessor modules 732, the return code and file name are returned to the P&B sub-manager module 710. This record is written out to the P&B error report file 740.

The P&B sub-manager module repeats the steps for all activity records associated with the transaction.

4. Firm Inventory Module

The firm inventory module 66 as depicted in FIG 3 of the present invention, updates the P&B tables 62, as described above, and in addition, maintains account lot lists for liquidating securities held in firm accounts. Utilizing the present invention, firm security position holdings are ordered and can be liquidated using a first-in-first-out (FIFO) or other liquidation method.

The firm inventory module 66 calculates net profit and loss for securities held in firm accounts on a trade date and settlement date basis, according to lot liquidation method, and further, it calculates cost of carrying securities from settlement date to liquidation date.

FIG 20 depicts the process flow of the firm inventory module 66. As implemented in the exemplary three-tiered hardware environment of PC, minicomputer and mainframe, the modules comprising

the firm inventory module 66 reside in the mainframe environment 36.

The primary data inputs to the firm inventory module 66 are: 1) executed trade records from the trade entry modules 48; and 2) entitlement records from the dividends interest and redemptions module (DIR) 70. The main input feed is the trade entry modules 42; from it firm inventory receives executed buy and sell records, "as of" trades and cancelled and corrected trade records. An "as of" trade is a trade entered into the system on the current date but effective "as of" an earlier date. The DIR module 70 sends stock and cash entitlement information, such as stock and cash dividends.

The minicomputer based-trade entry module 42 and mainframe based DIR module 70 write input records to corresponding massive storage tables 808, 810 resident on the mainframe (see also FIG 3, 44), from which the modules of firm inventory will access the data. For trade entry records, the store and forward module 42 takes the records from the minicomputer-resident store and forward log 43 and writes them to the massive storage table 808. The mainframe resident store and forward notification module 46 receives a reference number to the massive storage table record. The reference number is sent to an input queue 818 and received by a firm inventory access module 820.

A mainframe-resident transaction processing modules, such as the DIR module 70, writes information directly to its storage table 810.

In a batch process, at the end of the processing

day, the firm inventory access module 820 reads the data records 808 or 810 and simultaneously passes them to a firm inventory P&B update module 822 and a trade lot processing module 824.

The firm inventory P&B update module 822 processes the input data by invoking the P&B manager module 600 and sending it relevant data and a transaction code. The P&B manager module 600 receives all firm principal transactions from the trade entry modules 42, as well as data from the DIR module 70 on scheduled security entitlements related to firm principle trades, such as stock share dividends. Cash entitlement records from the DIR module 70 are not recorded in position and balance files 62. Those entitlements, however, are tracked by the firm inventory module 66 to determine net profit and loss and to determine the cost of carry.

A trade lot processing module 824 applies the trade entry and DIR data to files grouped as liquidation schedule lots 806 using a predetermined liquidation method. Security positions can be liquidated on a FIFO or other basis, such as maximize/minimize profit, or maximize/minimize long term capital gain. A user can choose the liquidation method for a security position when entering the trade. A default liquidation method, such as FIFO, is otherwise utilized.

Transaction records that "build" in an account position, such as a stock purchase, are added to open position lot files 826 and 827. Transaction records that subtract from or "close" a position, (such as a stock sell), are maintained in closed position lot files 828, 829. Cancel and correct

lot files 830 and 831 are used to alter corrected open or closed lot entries as well as create cancelled lot entries. Open lot 826, 827, closed lot, 828, 829, and cancel lot 830, 831, files are maintained by trade date and settlement date.

The firm inventory module uses the figuration routines 212 from the general reference databases, described above, to and access information stored in the product master database 206, and to calculate realized profit and loss. Realized profit and loss records are maintained in, the closed lot files 828, 829.

The present invention maintains liquidation processing order even against "as of" and cancels or correct processing of the lot lists. "As of" processing is described more fully below using FIG 23b. However, a lot unwind/rewind module 894 performs "as of" and correction processing. The unwind module rolls the open and closed lots 826, 828 to the point of the "as of" update or correction. The rewind module 894 processes the trades subsequent to the correction. The rewind module 894 accesses past input from the massive storage tables 808, 810 to reprocess the open and closed files.

FIG 20b desribed below, depicts the lot record movement in handling an "as of" posting to FIFO-based open and closed lot files.

Referring to FIG 20, the present invention also comprises batch processing modules 858, 863 to access P&B firm account tables 604, 610 to create settlement date lot positions. At the end of each

business day for a branch of a securities trading firm, the settlement date batch processing module 863 reads the massive storage tables 808, 810 and creates settlement date lot file entries 827, 829 for each security that is due to settle during the next day. The new settlement date records are entered into the settlement date lot processing files 827 by the chosen liquidation method (e.g. FIFO).

In addition, the P&B settlement date update module 858 creates, in batch, P&B table 62 updates for the securities held in firm trading accounts that are expected to settle ("settlement date set up"). At the end of the business day for a branch of a securities trading firm, the P&B settlement date update module 858 reads the firm account trade date file 610 in the P&B database 600 and creates firm account settlement date file 614 record entries for all the trades expected to settle on the following day.

During end-of-day batch processing of the firm trade date P&B file 610, the P&B settlement date update module 858 records accumulated unsettled sales. As financing is based on settlement date position, less risk and better financial terms are available for a broker when the positions held have already been sold.

The batch settlement date module 858 also triggers a batch process module 864 to compute the cost of carry for all records in the settlement date position and balance table 610.

The cost of carry is the amount of money it costs a

securities trading firm to hold the securities, instead of investing its money on other products. The cost of carry is a sum of any financing charges incurred in borrowing money to pay for the securities plus the lost interest a securities firm could have made by loaning the money instead of purchasing the securities. The cost of carry computation module 864 calculates those charges for all records in the settlement date positioned balance table 610 allocates the costs against the profit and loss accounts.

Cost of carry is determined by taking all settlement costs and applying a collateralization formula. A money store module 868 calculates collateralization based upon such figures as the previous days bank loan rates. Cost of carry records are written in a net carry file 870, allocating the carrying cost to specific firm trading accounts. To determine what calculation formula to use, the cost of carry module employs a product classification tree 214, and the product master database 206 for calculating treasury and finance category information.

For failed trades that do not clear on the projected settlement date, the cost of carry account file 870 is updated by the clearance system as will be described below. A failed trade processing module 867 of clearance credits the cost of carry against each account for the days where securities were not actually carried because the trade failed to settle.

In addition, there is a linking module 878 used to potentially offset some of the cost of carry. A

convertible arbitrage position linking module 878 links offsetting trades for convertible-type securities in an attempt to identify valid convertible arbitrages.

In addition to calculating the cost of carry, the present invention also comprises additional modules to make other firm account calculations. A deferred earnings module 904 calculates deferred earnings for discounted securities for users that choose to realize profit and loss on a trade date basis. The present invention comprises an unrealized profit and loss calculation module 906 to track trade date and settlement date positions and calculates on a sales against a cost basis.

Unrealized profit and loss totals are maintained in an unrealized P&L file 907. Statistics such as turnover, and aging are tracked by a position statistic module 908. Statistic totals are stored on the P&B firm account tables 604, 610.

On a settlement date basis, other modules calculate cost accretion for discounted securities, 910, settlement date position earnings 912, as well as the cost of carry described above. Profit and loss is aggregated on a monthly 916, yearly 918 and life to date basis 920.

A report processing module 900 accesses the position earnings files 916, 918, 920, 855, the position statistics file 909, the unrealized P&L file 907, the price accretion file 911 and the cost of carry total file 870 to create firm inventory reports 901.

In addition to the report output generated, firm inventory also updates the general ledger interface system described below and the money store system tables 868.

The present invention also comprises a manual adjustment module 902 that permits users to make manual corrections to the firm position lot files. A user can view the firm inventory lot files 806, using an on-line, front-end module 904. Manual adjustments to either the position file or the lot files will trigger the lot unwind/rewind module 894 in appropriate circumstances to change lot order.

The viewing module 904 comprises a function to examine the open lot files 826-827. The viewing module 904 has the ability to view the open lots using different liquidation strategies, such as FIFO.

An example of lot processing file action is shown in FIG 20a. Suppose the trade entry module sends records of IBM stock purchase activity for Account 1 to the firm inventory module. Initially, there are three records: two buy transactions 832, 834 and a later sell 836. Trade 1 832 and then trade 2 834 are entered into a trade date, FIFO open position lot file 826. Trade 3 836, the sell trade input 836 will liquidate the built position 838 + 840 in IBM for Account 1. The information from trade 3 is used to liquidate the securities from the open lot file 826 on a FIFO basis. Entry 838a in the open lot file 826a shows the results of the update. An entry 842 is made to a FIFO trade date closed lot file 828 which shows the liquidated stock.

FIG 20b depicts the lot record movement in handling an "as of" posting to FIFO based open and closed lot files.

FIG 20b, shows data obtained from the trade entry modules 48 for three trades: T1 832; T2 834; and T3 836. The listing at 826 and 828 reveal partial file listings for the trade date open and closed position lot files. Trade record, T4 890 arrives; it has an "as of" effective date prior to the records previously processed. Referring back to FIG 20, the firm inventory unwinding module 894 reviews the closed lots, processing back to the effective date of the "as of" record, and reprocesses the trades from that date by inserting the "as of" record in its appropriate lot sequence. As mentioned above, the massive storage table 808, 810 in the mainframe environment 36 contains all data input from the trade entry modules 42 and DIR 70. The unwind/rewind module 894 reviews the trade entry module data table 808 until the "as of" can be placed in proper sequence. Then, the unwind/rewind module 894 rebuilds the open trade lot file 826 adding the "as of" trade in its proper sequence then re-adding the subsequent trades.

A batch reconciliation module 898 matches the lot liquidation files 806 with position and balance database 600 files. The reconciliation module 898 submits any breaks occurring to a report facility 900 that generates reports. Researched breaks can be manually adjusted using the manual adjustment module 902.

5. Customer Accounts Module

The customer accounts module 68 of the present invention comprises functions of monitoring customer accounts, performing customer accounting functions, logging customer activities and generating periodic customer statements. As implemented for a securities trading organization, the customers of the organization can hold two basic types of accounts, cash and margin. There are, however, different sub-type classes of margin accounts such as a short account. For margin accounts, the task of monitoring the buy and sell activities of the customer and producing customer balances is complex.

For example Regulation T, promulgated by the Board of Governors of the Federal Reserve, places requirements on the amount of funds available to pay for security transactions. Tracking special memorandum account funds "SMA" is a method of keeping track of the customer account funds available to be applied either to meet either Regulation T's "initial margin requirements" on new transactions or customer requests for withdrawal of funds. As shown in Appendix VIII, many different transaction inputs affect SMA calculations. The basic rule is that any activity that changes a cash or security position impacts SMA calculation. However, activities that increase debit balance, such as debit interest, does not impact SMA. As implemented for a securities trading organization, the customer accounts module 68 comprises software to implement government regulation and firm imposed constraints on SMA calculation. Where SMA becomes negative because of trade related activities, a notice such on a "Fed Call" or a "Reg T Call" is sent to the customer.

In addition, the customer accounts module (68 as implemented for a securities trading organization) comprises modules to calculate maintenance margin balances. Maintenance margin is calculated to determine if a customer is under-margined according to the standards of the trading firm itself or an exchange such as the New York Stock Exchange. If a customer is under-margined a notice, such as a "house exception" or a "NYSE exception", is issued.

Further, the customer account module 68 of the present invention comprises modules to process margin and customer account exceptions in addition to the Regulation T and house maintenance notices. The additional exceptions comprise the processing of standard industry balance indicators including: minimum equity balances; unsecured exceptions; technical short exceptions; liquidation exceptions; day trade exceptions; 90 day restriction exceptions; excess available exceptions; customer account record keeping exceptions, position and balance exceptions and other exceptions that are defined more fully in Appendix IX. The customer account module 68 maintains all exceptions and, on a daily basis, handles their aging or new issuance as described below.

The customer account module 68 of the present invention also comprises modules to debit and credit interest due on customer accounts. Cash and margin account cash balances are summed and multiplied by an applicable margin interest rate to derive margin interest. The prevent invention is comprised to accrue debit and credit interest nightly and post interest to the general ledger module 72 and cash management system module 54 at

the end of monthly interest periods.

The basic systems process flow comprising the customer account module is depicted in FIGS 21a and 21b.

The basic functions of the customer accounts module 68 comprise: 1) a daily gathering of transaction events, which occurs both on-line during the day and in batch at the end of business; and 2) batch calculations processes to calculate margin requirements and other customer balances.

i. Activity Capture

FIGS 21a-b depict the modules that function to collect, both on-line and in batch, daily customer account transaction records. An activity table 930 (located, as a preferred embodiment of the invention in the mainframe environment massive storage tables 44) is the storage area for transaction data pertaining to customer accounts. The customer accounts module 68 receives data from a number of sources on-line, makes appropriate entries to the activity table 930 and in some cases sends customer information to the transaction processing modules.

The transaction entry modules 48 notifies the customer account module, (on a real-time basis using the store and forward modules 41, 42), of: 1) customer trades on trade date; and 2) cancelled customer trades entered after settlement date. For each notification, a post trades module 926 reads the customer transaction from the mainframe resident executed transaction table (See 44, FIG 3)

and creates an activity record in the customer account activity table 930. For cancelled customer trades after settlement date, the post trades module 926 will also send record of the customer cancel to the cash management system CAMS 54, clearance 52, and general ledger interface (GLI) 72 modules using customer account interface modules 927, 931, 932.

As monies for transactions related to customer accounts are received by the CAMS module 54, record of the receipt or payment of money by check or wire is sent, (using the store and forward modules 41, 42), to the customer accounts module 68. A post CAMS activity module 936 records the transaction event in the customer account activity table 930 and, in addition, sends record of the wire receipt to the GLI interface module 944, which forwards the record to the GLI module 72.

In the personal computer environment 20, a customer account front-end module 934 sends transaction data to the customer account module 68. On a PC, an activity update screen function permits customer account operators input transaction data concerning: 1) manually initiated payment requests; 2) manually initiated account updates on monies or securities; and 3) free receives of securities to be used as margin collateral for each of these inputs. A mainframe resident customer account on-line module 933 will create an update to the customer account activity file 930. For manually initiated payment requests, the customer on-line module 933 will send request data to a CAMS payment request module 928, (as the CAMS module 54 integrates all actual cash movement in the present

invention) and to the GLI interface module 932 to forward to the general ledger interface module 72. Manually initiated updates of quantities of securities and data on free receives against money details are also forwarded in a similar manner by the customer on line module 946 to the CAMS 54 and GLI 72 modules. Free receive data and manual account update data are forwarded to a customer P&B interface module 929. The data is sent to the P&B module 64 for processing with a transaction code as described above.

In addition to the account update screen function, described above, the customer account front-end module 38 comprises an inquiry function to users to view current customer balances. A "shadow posting function" will show customer account activity records 930 juxtiposed with current balance information. In addition, the inquiry feature of the front-end module 934 permits users to save notes on customer accounts in a customer memo 971 and a customer status table 969.

In real-time, the DIR module 70 sends to the customer account module 68 transaction data on cash entitlements and security quantity entitlements received on or after the date of payment. DIR records can also be accepted on a pending status basis. A post entitlements module 925 creates record updates to the customer accounts activity file 930. For cash entitlement records, the post entitlements module 925 sends the update to the CAMS module 54, (using the call minicomputer module 45 (see Fig 3)), and the general ledger interface module 72, (using GLI interface module 932). The post entitlements module 925 sends quantity

entitlement records to the P&B module 64, using the customer P&B interface module 929 as described above. In addition the DIR module 70 will send to the customer account module 68 transaction data on pending entitlements. In those situations, the DIR Interface Module will post the entitlement record on a pending status basis to the customer activity table 930. Later, when the entitlement issues, the customer accounts 68 module will update the CAMS 54 and GLI 72 modules.

The present invention also comprises links with outside transaction data sources. Using the example of a securities trading firm, customers can transfer accounts from one broker to another using the Automatic Customer Account Transfer System "ACATS" 936. Also, trading firms often arrange with intra-firm money market accounts to permit customers to transfer funds between the firm and outside firm money market accounts 938.

A post-ACATS module 935 receives and sends information in batch on account transfers and ACATS transmissions. The post-ACATS module 935 also creates activity records and forwards corresponding records to the GLI 72, CAMS 54 and P&B 64 modules, as well as making updates to the customer activity file 930.

A post money market account module 937 receives and sends in batch fund transfer information from outside money market sources 938. In addition to updating the activity file 930, the post money market module 937 sends records of funds transfer to the GLI 72 and CAMS 54 modules in the manner described above.

ii. Settlement and Margin Calculations Exceptions and Interest

The margin calculate module 960 is a batch process that accepts and processes all the activities 930 entered during the course of the day. Its process flow is depicted in FIG 21b. The functionality comprises modules to adjust account balances, maintain regulatory requirements, summarizes market value, calculate account interest, note exceptions where necessary, and compile data for exception and other reporting and notification.

The functional system flow is divided into four steps:

1) check each customer and decides if there are any activities to process; calculate impact on SMA and house maintenance margin levels; issue trade-related exceptions;

2) clear all trades whose settlement date has arrived;

3) review the customer tables to note any exceptions that may be applicable;

4) accrue interest daily and notify the GLI module 72 of the daily accrual.

In addition to the transaction gathering modules and the activity table 930 described above, the

customer accounts module 68 comprises an initial margin module 942, a house maintenance module 944, a margins settlement balances module 946, an exceptions calculation module 948, a notice authorization module 950, a debit/credit interest module 954 and a reporting module 979. The activity table records 930 are used primarily to update a customer account balances table 965 and customer sub-account balances table 967. The customer account balances table holds account balances by trade date and settlement date, as well as totals for SMA monies needed to meet initial margin requirements. The customer sub-account balances table 967 holds trade date and settlement date account totals by sub-account, as well as SMA and initial margin requirements for customer accounts as broken down by sub-accounts, such as Customer A-"CASH" Customer A-"MARGIN" and Customer A-"SHORT".

The initial margin regulation T requirements are checked by the margin calculation module 942.

Initial margin requirements, or Regulation T requirements, are stored and maintained in a margin requirements table 962. The information will be kept by product classification type and entered by operators at the securities trading firm. This margin requirement table is a PCS classification tree (as in FIG 7, 214). Initial margin requirements also depend upon price for equities, ratings for bonds and time to maturity for U.S. Government obligations which are retrieved from the firm price management database 210. Firm initiated overrides of the initial margin requirements for a product, product classification, a particular

customer, or customer range are used by the initial margin module and are stored in a margin requirements override table 963.

To determine if a margin account activities are able to pass the initial margin requirement of Regulation T, the initial margin module 942 calculates the SMA for each customer account, in a five step iterative process. If the calculated SMA is less than the required initial margin required, then a "Fed Call" notice must be sent to the customer.

For each customer account, the initial margin module 960 takes the transaction activities (from the customer activity table 930) for that account and updates the account and sub-account balances 965, 967.

The initial margin module 642 also computes SMA, by beginning with the opening SMA (found in the customer's account balance table 965) and nets with all non-trade related activities that impact SMA from the customer activity table 930. The initial margin module 960 distinguishes between trade and non-trade customer activity records 930, and it determines whether a particular activity will impact SMA by referencing an activity matrix table 960. Entries in the activity matrix table 960 (as shown in Appendix VIII) describes the impact upon SMA for all possible activities and whether an activity is considered to be trade or non-trade related. Non-trade related changes are first added to the old SMA value.

With this figure, the initial margin module 942

reduces any outstanding "Fed Call" notices for additional payment. An exception table 970 holds records of outstanding call notices and their values.

Next the initial margin module 942 will net trade-related activity records from the customer activity table 930 as determined by using the activity matrix table 960. The trade related activity will cause further adjustments to a customer account's SMA.

This adjusted SMA value will be compared against the initial margin requirements for the particular transactions making up that account. The initial margin module 942 determines the initial margin requirements for a particular account by accessing the margin requirements table 962 (in the manner of accessing a PCS tree as described above). If there is inadequate SMA to meet the initial margin requirements, the initial margin module 942, (if the customer has authorized the company to), will automatically move enough money to meet the requirement from a cash account 938 to the margin account; and 2) initiate the appropriate GLI 72 update. After any movement of money if SMA is negative due to trade related activities that amount becomes the amount of Fed Call needed.

If a Fed Call notice is required, the initial margin module 942 creates a request for a Fed Call by placing record of the margin deficit in the exception table 970.

Where a Fed Call is to be issued, the SMA for the account is zero. If there is no Fed Call, the

initial margin module 942 calculates "excess". Excess is the difference between market value of securities in the account minus debit balance and initial margin requirements. If the excess is greater than current SMA, the initial margin module 942 adds the difference to the SMA, otherwise the current SMA is the closing SMA.

To determine securities market value, the initial margin module 942 invokes a mark to market module (MTM) 952. MTM 952 will value the securities in the P&B settlement date customer account file 616.

In addition to the initial margin module 942, the house maintenance margin module (MMM) 944 performs calculations to determine if a customer account is under margined. If a customer account is undermargined, a "house" and/or other maintenance exception (such as NYSE) is issued.

To begin, MMM 944 will total the trade date money balances in the margin and short sub-accounts found for each customer in the customer sub-account balance table 967. To value all trade date positions in each customer's margin and short accounts, the MMM module 944 searches the P&B file customer trade date position table 602 and values the positions there, using data from the firm price management database 210. MMM 644 will next calculate the customer's house and NYSE maintenance requirements based on trade date positions. The house and NYSE requirement percentages are retrieved from the margin requirement table 962 and the override table 963.

The margin override table 963 contains priority

margin requirements for specific customer ranges, specific customers, products, product classifications or a combination of the above.

The customer settlement balance module (CSBM) 946 is invoked, at the end of trade settlement date, to determine whether customer account trades should clear or fail, based on current account status. If the transaction is a customer buy, CSBM 946 deterines whether the customer account has sufficient funds to make the purchase. If the transaction is a customer sell, CSBM 946 determines whether the customer has maintained a sufficient position to complete the transactions. CSBM 946 accesses data on trade settlement activity from the clearance main file 60, matching settlement transaction records against customer account balance records 965, 967.

From the comparisons, CSBM 946 initiates updates to the customer account balance tables 965, 967 and the P&B customer memo table 614. The customer account money balances tables 965, 967 track an assumed settled balance (assuming all transactions donot fail) and a fail settlement balance. The customer memo table 614 updates are forwarded (with transaction code) to the P&B manager module 64.

In addition, if a trade is failing, in certain circumstances an extension in time to settle the transaction can be granted by a trading entity such as the New York Stock Exchange. An extension update module 942 determines whether an extension can be applied for and if so, creates a record update NYSE extension table 977 that will be transmitted to the NYSE.

In addition to the Fed Call, house call and NYSE exceptions, an exception processing module 948 checks the account balance files 965, 967 for other possible customer account problems.

For example, a minimum equity requirement amount is a user maintained field in the margin requirements table 962. The exception processing module 948 compares this amount with the total equity within the customer's account 965, which includes all sub-account types. This exception is calculated when a customer's position is increased in the margin account by margin buys and short sells. For margin buys, if the minimum equity requirement amount is greater than the total equity, an exception will be issued. The exception amount will be the trade amount or the minimum equity requirement amount whichever is lower. For short sells, if the minimum equity requirement amount is greater than the total equity, an exception will be issued. The exception amount will be the amount that will bring the total equity to the minimum equity requirement amount. This exception can be issued any time after total equity has been calculated. Other exceptions are described in Appendix IX.

The notice authorization module 950 will generate a notice authorization table 975 from the exception table 970. The notice authorization table 975 will be rebuilt from the new exception table 970 at the end of the batch process every night. The table once built is forwarded to an outside source 976 for 24 hour around printing and delivery. The notice authorization table 975 consists of the following four notice types:

1) Sell-Out Notice - This notice is generated by past due Fed Call, or past due Cash Due exceptions that have not yet been reduced two business days before the due date of the exception;

2) Regulation T Margin Call Notice - This notice is generated by new Fed Calls. The money amount for this notice will only include the Fed Call amount of the trades with today's trade date;

3) Buy-In Notice - This notice is generated by the Tech Short (see Appendix IX) exception on the thirteenth business day from trade date;

4) House Call Notice - This notice is generated by new House Call exceptions.

At the end of the batch cycle, after the exception table 970 has been updated, the old notice authorization table 975 will be deleted. The notice authorization module 950 will calculate the due dates for exceptions that may appear on the notice authorization table 975. The notice authorization module 950 will add the authorized notices to the notice authorization table 975 based on exceptions on the exception table 970. The notice due date is used to notify the customer when

the cash or securities must be delivered to the securities trading firm. The notice display date is used to control when a notice is to be displayed. And in addition, the notice authorization module 950 checks the NYSE extension table 977 before determining that a notice is to be displayed.

After all relevant exceptions have their notice due dates and notice display dates are calculated, the notice authorization module 950 writes to the notice authorization table 975 all exceptions having a notice display date equal to next business date. This table contains all the notices that need to be sent out for the next business date. The notice authorization table 975 can then be downloaded or transferred to a notice printing service 978 for 24-hour notice mailing.

All active exceptions are placed on the exception table 970. An exception will either be issued new or aged, depending on the exception. Exceptions that are issued new are removed from the activity table 930 at the end of the next day. If the condition exists again it will be issued as a separate occurrence of the exception. Aged exceptions remain on the exception table 970 until the exception condition no longer exists.

The debit/credit interest module 954 sums and multiplies the applicable margin interest rates to derive margin interest. Debit and credit interest will accrue nightly and be posted to the general ledger 72 and the cash management system 54 at the end of the monthly interest period.

An interest rate table 964 is accessed to determine the interest rate to be used. Separate rates are maintained for debit interest and credit interest. An interest rate consists of a base rate and a possible additional basis point offset rate that is added to or subtracted from the base rate. The offset rate be for either the range of customers or the specific customer. The customer account reference table 208, described above, indicates if the customer has this preferential interest rate. The range can be institutional, retail or employee. If a customer has a preferential rate then that offset will take precedence over the range offset rate.

Debit interest is only calculated if there is a debit balance in the margin account. The customer's debit/credit balance is calculated by netting the actual settlement date balances across the margin cash sub-accounts 967. The market value of technical shorts and illogical memo positions (where P&B memo positions do not match the customer settlement date positions, See Appendix X) are backed out of the customer balances. This will either decrease the credit balance or increase the debit balance. After calculating the interest rate, the daily accrued amount is added to an interest rate detail table 972, where it is maintained through the interest period. The interest accrual is stored and reported by interest rate periods. These periods change when the base interest rate is changed and at month end.

A reporting payment and posting module 976 creates customer statements and other industry required compliance reports. The payment and position

function of the module 976 is to initiate the CAMS payment requires update module 939 to make payment request for customer accounts that are profiled (in customer status 969) to be paid monthly. In a batch process, the CAMS payment request update module 939 will send an update to the CAMS module 54 (directing it to send a check) and update the customer balance files 965, 967.

6. Trade Clearance Module

The clearance module 52 depicted in FIG 3 of the present invention tracks and records all clearance activity related to a trade and in addition updates the position and balance location files. As the transaction processor of the present invention is implemented for a securities trading firm, tracking and recording clearance information includes tracking security buy and sell transactions from the time the transaction is booked until the time that either 1) securities or payment is exchanged in satisfaction of the trade on settlement date or 2) a settlement is received for failed trades. The primary focus of the clearance module is the flow of securities to and from accounts held by a trading firm at various security clearinghouse locations. That focus is on "streetside" receipt and delivery, not customer ownership and control. Thus, the clearance system output is integrated into position and balance database 600 to update the P&B location files.

Because the clearance module handles the receipt and delivery of cash in satisfaction of trades, its output is also an input for the cash management module (CAMS) 54. As is be described above, CAMS

is the systems central management module for all cash flow that relates to trades. As the clearance module receives information on cash received for securities delivered, the clearance module passes that data to CAMS.

In addition to handling security receipt and delivery, the clearance module is also arranged to provide reports of pending settlement activity, and project pending settlement totals. Before settlement date, the clearance module attempts to consolidate clearing activity by pairing offset trades. If a trade fails to settle on the projected date, the clearance module tracks the failed trade until its ultimate settlement.

As the clearance module is implemented in the three-tiered system, described in FIG 1, many of the clearance module program elements to be described below reside in the minicomputer environment. Function modules related to position and balance maintenance reside in the mainframe environment.

i. Trade is Booked

FIG 22a depicts the on-line process flow for the clearance module after a trade is "booked" by the trade entry module depicted in FIG 22a at 980. The trade entry module 980 notifies several modules, e.g. firm inventory, CAMS and the clearance module of the trade booking. Notification travels through the generic distribution mechanism module as depicted at 982 and it arrives at a clearance system message queue 984. A receipt module 986 calls the a trade entry

accessor module 988 to gather clearance related trade facts from the executed trade file depicted at 990. Appendix VIII shows the data retrieved by the accessor module 988. The receipt module 986 writes the data to a log file 992 and notifies a clearance manager module 994 by sending a message to its notification queue 996.

Asynchronously, the clearance manager module 994 awakes and reads the intermediate log file 992 for the new trade details. To gather additional clearance related details, the clearance manager module 994 accesses one or more product classification Systems (PCS) trees, 998, 1000, using the product classification system access routines 1002. One depicted PCS tree 998 maintains the product class identifier for the security type entered. The second depicted tree 1000 maintains an attribute identifier number and the class name of the security. Using location information gathered with the PCS trees 998, 1000, the clearance manager module 994 accesses information from the product master database 1004 using a product master accessor module 1006. Trade related details furnish information as to the current location of the securities, delivery instructions, product and account access codes, and other clearance related information.

The clearance manager module 994 next stores the executed trade data sent from the trade entry module 980. The clearance manager module 994 accesses a clearance IO manager 1008 to record the expectation of the receipt or delivery of securities to a clearance main file 1010 and a clearance detail file 1012. The clearance main

file 1010 is the central repository of information regarding the receipt and delivery of securities and cash resulting from clearance activities. A record is written to the clearance main file 1010 for each new trade. There is a one-to-one correspondence between a clearance file record and the original trade input data.

Associated with the clearance file is the clearance detail file 1012. For every clearance activity performed, a record is written to the clearance detail file 1012. There may be one or more clearance detail records for every clearance main file 1010 record. Activities which result in the creation of a clearance detail records include: 1) the original booking of the trade; 2) a trade cancellation or correction; 3) a transmission of a trade to a clearing entity; 4) acknowledgement of clearance from a clearing entity; 5) a pair-off confirmation; 6) receipt or delivery of full or partial amount of the security quantity or trade proceeds; and 7) trades going into fail status. The clearance main file 1010 records and the clearance detail file 1012 records are also sent to the store and forward log, depicted in FIG 22a at 1014 to be shipped to clearance massive storage tables for data in the mainframe environment.

The clearance manager module 994 also updates the position and balance database 600 by invoking the mainframe-based position and balance manager routines depicted in FIG 22a at 1016. As described above, the position and balance manager will create appropriate updates to the trade date location and other files in the P&B database 600.

Finally, the clearance manager module 994 invokes a line-up manager routine 1018 to update line-up projection file 1020, if necessary. Line-ups is a function of the clearance module that reports upcoming settling activity and projects end-of-day settlement totals. The primary clearance window time for the line-up file begin one day prior to the settlement date and ends on settlement date. Should a newly entered transaction expect to settle within the time window of the line-up manager module 1018, the transaction will be added immediately to a line up file 1020. In addition, the line-up manager 1018 sends a corresponding entry to a mainframe-resident massive storage table via the store and forward log 1014. Profit information, displayed with the line up file 1020 is calculated asynchronously, using one or more firm pricing modules 1022, 1024 that access the product master database depicted in FIG 22a at 1006. Using the clearance IO manager module 1008, the line-up manager module 1018 updates the line-up file 1014 with price information and updates the store and forward log 1014.

ii. Line Up Processing

Line-up processing is a function of the present invention that provides the ability to report pending activity and projected settled positions. The repository of settlement information, the "line-up file" is created largely in batch process during the end-of-day processing. However, as described above the line-up file can be updated by immediately pending trades, on-line, during the day.

As created in the overnight process, a line-up module sorts through the position and balance database 600 and extracts all securities that are due to settle the next day. That list includes all failed trades. In addition, the line up projection file lists all files that are due to clear within the near future, for example within the next five days.

And on-line function permits users to view the projected settlements. For each security issue, a projection is created for the end-of-day versus segregated positions. This involves netting start-of-day positions with anticipated settlement activity. The projections are used to 1) identify short positions that show whether a borrow or resale should be initiated, 2) identify surplus inventory to be used in repurchase agreements or loans, 3) pass cash projection figures to facilitate cash management.

iii. Trade Pair-Offs

Another function of the clearance module depicted in FIG 3 is its ability to pair-off trades. The pairing-off function allows users to match all offsetting buy and sell trades to reduce the overall movement of cash and securities. The function reduces physical movement of cash and securities by offsetting buys and sells for the same customer. Pair-offs can minimize trade fails and reduce fail costs, because pairing-off reduces the number of transactions that need to clear.

Pair-offs is a front-end function of the clearance module. It's process flow is described in FIG 22b.

The function is invoked by user input from a PC front-end module 1030. A minicomputer-based pair-off manager module 1032, begins sorting through the clearance main file 1010, identifying potential pair-offs for a customer. As implemented in the present invention, the pair-off manager module 1032 applies a sort criteria to determine potential pair-offs by: settlement date, security type; customer account; and by offsetting sell against buys.

Once trades are paired, record of the pairing is written to several files. The clearance manager module 994 updates each trade record in the clearance main file 1010, and in addition creates a new pair-off entry for the clearance main file 1010. The clearance manager module 994 also creates new entries in the clearance detail file 1012. The updates are completed using the clearance IO manager module 1008. Corresponding updates are made in the store and forward log 1014.

The pair-off manager module 1032 also uses the clearance IO manager module 1008 to update several pair-off record keeping files. A pair-off main file 1034 contains one record per pair-off regardless of how many trades are involved in the pairing. The pair-off manager module 1032 assigns a pair-off number to each record added to that file. A pair-off activity file 1036 contains records detailing subsequent events that occur to the pair-off. A one to many relationship exists between entries in the pair off activity file 1036 and entries in the pair-off main file 1034. As a pair-off event occurs (e.g. payment made on a pair-off) a record is added to the pair-off

activity file 1036. A pair-off trade relate file 1038 maintains the relationship between the assigned pair-off number and the trades that the pair-off relates to.

Finally, the pair-off manager module 1032 sends notification of the pair-off to the cash management module depicted in FIG 22b at 1040. The CAMS module as described above uses pair-off information to alter the payables and receivables it expects to receive.

iv. Receipt and Delivery

The process flow for clearing trades is depicted in FIG 22c. The receipt and delivery process begins in the evening or the morning before of trade settlement. A background processing routine called communication manager module 1042 sends lists of trades that the firm expects to one or more clearinghouse banks 1043 and communicates over wire services with the clearinghouse banks while sending the lists to them. Communication links for the communication manager 1042 are created over established wire services.

As an exemplary embodiment of the present invention, it is recommended that the communication manager module exist in a fault tolerant mini-computer environment and communicate with the outside world 1043 via transmission lines that support a X.25 bisynchronous protocol.

The communications manager module 1042 establishes CPU to CPU links with each clearing bank 1043 and, after sifting through the clearance main file 1010,

sends to each clearing point bank a list of the securities expected to clear there. An outgoing communications log 1044 contains all records of transmissions sent to the clearing banks 1043.

During the trading day, linked clearing house banks 1043 transmit clearing information concerning both cash and security flows. An incoming communications log 1046 contains all records received from a clearing bank. A communications control file 1048 contains a record representing the incoming and outgoing control information for each linked bank 1043. As the communications manager module 1042 receives information, it notifies the clearance manager module 994. Cleared trade information can also be inputted on-line, using a PC-resident front-end function 1050.

Asynchronously, the clearance manager module 994 reads the contents of the incoming communications log 1046. For cash flow records, the clearance manager module 994 sends the data to the CAMS log file 1040 for processing by the cash management-system module.

For security movement records, the clearance manager module 994 first updates the clearance main file 1010 and also creates a detail record for the clearance detail file 1012. The clearance IO manager module 1008 writes to those files and also updates the store and forward log depicted in FIG 22c at 1014. For paired trades received, the clearance manager module 994 invokes the pair-off manager module 1032 to make the proper file updates 1032. Clearance manager module 994 also invokes the line-up manager 1018. In addition to updating

the projected line up file 1020, the line-up manager 1018 also invokes the clearance IO manager module 1008 to update the line-up location file 1056. That file contains netted security location information on the basis of one record per bank and product type.

In addition, clearance manager 994 invokes the minicomputer-based position and balance manager module depicted in FIG 22c at 1016. The P&B manager module 1016 creates, updates and sends to the P&B database 600 data that reflects the actual receipt of securities. Those updates alter the batch processed settlement date failed to receive code "F/R" positions, described in the position and balance section above.

v. Failed Trade Processing

When a trade does not clear by the end of the business day of its scheduled settlement date, the trade fails.

A trade can fail because full payment was not received or the securities were not delivered on the assigned clearance date. The terms "fail-to-deliver" and "failed-to-receive" are used to refer to open trades in the transaction processor that have passed the assigned settlement date but have yet to be fully cleared. If a trade has been fully cleared for securities (i.e. securities are delivered) but an open money difference remains, the trade is still considered a failed trade. In the securities trading industry, firms are subject to regulatory reporting requirements for failed trades. For certain security products, customers

and brokers must be notified of a failed trade at specific time intervals.

FIG 22d depicts the process flow for gathering failed trades. An overnight batch process, a fail gathering module 1063, sorts through the clearance main file 1010 copying failed trades to a fail file 1064. The fail file 1064 is the central file for failed trades; it contains all fail costs and fail ages. There is a one-to-one correspondence between fail file record entries and actual failed trades. A fail activity file 1066 contains activity details associated with each fail. As fails are collected, the batch fail processing module 1063 updates the clearance main file 1010 and creates a detail record for the clearance detail file 1012. Credits are also computed for the cost of carrying the securities and sent to the firm inventory module depicted in FIG 22d at 1065 as described above.

FIG 22d also depicts the process flow as a failed trade clears. As described above, the incoming communication manager 1042 collects records of incoming settled trades from clearing house banks 1060. A record describing the settlement of a failed trade arrives in the incoming log file 1046 and is processed by the clearance manager module 994. As described above, the updates to the cash management system module CAMS 1040, to the clearance main and detail files 1010 and 1012, to the position and balance manager module 1016 and to the line-up manager module 1018 are completed. However, in addition, clearance manager module 994 also invokes a fail manager module 1062. The fail manager module updates the fail file 1064 and fail detail file 1066. The fail manager 1062 also

computes a cost of carry credit and the cost of fail for use by the firm inventory module 1068, as described above.

7. Dividends, Interest and Redemptions (DIR)

The present invention can include program modules used to calculate and process all entitlements related to a security position. As implemented for a securities trading organization, the dividends, interest and redemptions module (DIR) 70 collects and records the disbursement of security entitlements - dividends, interest and the redemption of principal through amortization of maturing securities.

As a matter of securities industry practice, the DIR module 70 must track entitlement information for securities products held in all firm, customer and location accounts. Equity entitlements require determining such facts as a declared ex-date, record date, payment date, and dividend rate. Debt entitlements require the derivation of such facts as a record date, payment date, last accrual date, interest rate, call rate and redemption rate. Mortgage-backed debt products additionally require a determination of factor date and factor rate.

Quantifying and allocating these entitlements is based on who holds a position in the security in relation to when its entitlement will be paid. The account holdings are used to project record date positions to facilitate distribution of cash or stock dividends and to obtain record date beneficial owners and locations for distribution

and collection of entitlements.

The DIR module 70 of the present invention provides a centralized and automated system to identify product entitlements and to process events related to entitlement distribution. For example, changes made to an entitlement cycle's payment dates or changes in an account's holdings mandate changes to the distribution amounts and collection of entitlements.

In addition, trades that are in fail status over record date or that are projected to settle within an entitlement's interim accounting period, require the distribution or collection of entitlements by attaching a record keeping feature called "a due bill" at time of clearance.

Entitlements in the form of money or stock must be collected from the issuer of the product. The ability to match receipts to receivables, age outstanding receivables, issue claims for receivables, and reconcile incoming receivables is an important record keeping function of the DIR module 70.

In addition, the DIR module 70 comprises a "proofsheet adjustment" function to handle new entitlement information as well as trade cancel or correct information during the entitlement period.

As an integrated feature of the present invention, the DIR module 70 uses information maintained by other transaction processing modules and the general reference databases 77, described above, to maintain entitlement information. As entitlements

are received and distributed, the DIR module also feeds information to other systems affected by DIR activity.

FIG 23 depicts the high level process flow of the DIR module 70.

The first step in the process is to organize basic data on entitlements. An entitlement announcement processing module (EASY) 1134 uses data from the product master database 206 and outside financial news services 1132 to create entitlement data tables 1135 that list security products, normally traded by the firm, on which entitlements become due.

A start-up processing module 1139 begins the entitlement distribution process by collecting information on securities product, listed in the EASY data table 135, whose entitlements cycle is going on record date. Recording of record date is important, because as a matter of securities industry practice, all holders of securities on record date will take the divident regardless of whether they sell the securities before the actual distribution date.

The start-up module 1139 takes information from the EASY data tables 1135 on securities which are soon to go on record date (1-3 days before record date) and writes those records to a start-up file 1141.

From the time security products are listed on the start-up file, until the actual record date, a clean-up module 1244 continually checks the current firm, customer and location holdings to report on

securities that are not positioned in such a way that the firm can receive and distribute the entitlement. The problem occurs when securities are held in either the "BOX" or "TRANSFER" position codes. The BOX position code means that the securities are held in a name other than the trading organization. Securities in "TRANSFER" means that the securities are between holders. If, on record date, either positions exist, the trading firm will not be entitled to receive the entitlement. From the time the security appears on the start up file 1139, until its record date, the clean up module 1244 checks entries in the start-up table against firm holdings in the P&B tables 62 for "BOX" and "TRANSFER" positions held on "started-up" products. A notification report is distributed on each BOX or TRANSFER position until record date.

For a given security on the start-up table 1141, clean up processing stops on record date and proofsheet processing begins. A proofsheet processing module 1136, accesses the start-up table 1141, the entitlements data table 1135 and the position and balance tables 62 to create balanced listings of entitlements due by account. As in the P&B tables 62, the netted firm and account positions balance against location positions. Proofsheet tables 1137 contain the balanced entitlement data. Records of entitlement on the proofsheet tables stay on those tables from record date until the time of entitlement distribution. In addition, the proofsheet module 1136 creates proofsheet reports 1140 and implements part of the phased distribution method.

Phased distribution is a standard practice in the securities industry, where securities traders are credited in firm accounts with entitlements on the night before record date, while customers are credited with entitlements on the night before actual payment. Accordingly, as a part of proofsheet processing, the proofsheet module 1132, sends account-side entitlement information to the firm inventory module 66, as described above.

A scheduling module 1142 looks again to the EASY data tables 1135 to discover when entitlements are going to come due for purposes of receipt and distribution. For products with entitlements that become due during the next day, the scheduling module then checks the proofsheet tables 1137 for positions in those products. The scheduling module 1142 creates a balanced entitlement transaction table 1143 by account (firm, customer and location), containing information on what receivables and payables are due and owing. Notice of the pending distribution is sent to the customer accounts 68 and firm inventory modules 66 as the second phase of phased distribution.

A receipt and distribution module (R&D) 1148 reads the entitlement transaction tables 1143 and creates updates for a payable and receivable table 1144 and detail table 1146. For cash distributions, the R&D module 1148 sends notification of the expected cash movements to the CAMS module 54. Distribution of security entitlements is maintained directly by DIR 70 through on-line input from sources like DTC 1154 and manual on-line input 1155. As CAMS receives cash entitlements, it notifies the R&D module 1148 of the receipt, and R&D will update the receipt and

detail files 1144, 1146.

In addition, the present invention further comprises a proofsheet adjustment module 1130 to handle trade cancel and correct data and entitlement alteration data.

i. Entitlement Announcement Processing

The purpose of the DIR entitlement announcement processing module 1134 (EASY) is to determine and record product periodic entitlement information. EASY will use the static and external information from the product master database 206 to formulate periodic entitlement information and provide access to this data based on entitlement dates. EASY processing is done when a product is added, when specific product changes are made, and at the beginning of each new entitlement cycle.

Entitlement information comes to EASY from the product master database 206 described above and from external data sources 1132. Vendor services are used to provide market information. For example, a service known as "IDSI" provides information on domestic corporate equity dividends. The "J.J. Kenny" service supplies information on municipal securities. The "Bond Buyer" service provides factor information for mortgage backed products sponsored by the federal government.

There is a considerable group of products for which information is not explicitly provided, including Corporate Debt, Treasuries (Bills, Notes, Bonds and Zero Coupons), Asset Backed Securities, Money

Market Securities (e.g., CD's), Hybrid Securities, (CMO's, STRIP's, etc.) and foreign debt and equity securities. For those securities, entitlement information is derived from the product master database 206. Information in prospectuses and indentures is entered on the product master database 206. That information is considered static, having little change throughout the life of the product. It is used to derive periodic entitlement dates and rates. Information provided by external sources 1132 (vendor services) provide dynamic entitlement data.

The creation of the entitlement list files 1135 is shown in FIG 23a. Raw entitlement data comes from updates to the minicomputer-based environment 32 product master reference database 206. (Data from external reporting services 1132 is received in the transaction processor system by the firm pricing modules 218 described above (See FIG 7)). The raw data together with product master database updates are sent to the store and forward log 43 for transport by the store and forward modules 41, 42 to a mainframe-based general storage table 44. The store and forward notification module 46 sends a message that information potentially relevant to DIR has been received.

Notification is passed (using a queue 1160) to an EASY program initiation module 1172. Asynchronously, the program intiation module 1172 interprets messages received from the notifier 46. The product data received are classified by intiation module 1172 to determine if further DIR processing needs to be invoked. If entitlement will be affected by the product information, the

initiation module 1172 next determines the criticality of the update and accordingly sends the data for either an asynchronous or background processing. Batch records have a low priority and will be processed in background, but critical events will be processed on-line. Update records for batch processing are stored in a batch processing log 1171. Critical records are fed to a queue 1176.

A subsequent action determination module 1178 receives data from the queue 1176 and sends the data to a next product recognition process -- add 1182, modify 1190, delete 1192, etc. -- based on the type of transaction code that came with the data from product master 206. To determine the subsequent entitlement events, the subsequent action module 1178 uses references maintained in an event reference table 1180 that are keyed by the transaction code.

The entitlement add, modify and delete modules 1182, 1190, 1192 derive entitlement dates, amounts based on product-type information. The subsequent action module 1178 looks at the new product data to determine whether entitlement cycles should be built, modified or deleted and invokes corresponding nodules.

For building new entitlement cycles, the following procedure is used, based on product information contained in the input as sorted against entries in an entitlement type table 1181: If a maturity date is not provided, the add module 1182 will then call a build maturity cycle module 1194 to determine and build the cycle.

If a "call" feature needs to be created, a call build call cycle module 1196 is invoked determine and build the cycle.

If the dividend rule feature indicator field is "on", in the input record, then the add module 1182 calls a build anticipated dividend cycle module 1198 to determine and build the cycle.

If the product feature dividend pay indicator field is "on" in the input record, the add module 1182 calls a build announced dividend cycle module 1200 to determine and build the dividend cycle.

If the interest feature indicator field is "on" in the input record, the action module 1182 calls a build interest cycle module 1202 to determine and build the interest cycle, if necessary.

If the factor feature indicator field is "on" in the input record, the action module calls a build principal paydown cycle module 1204 to determine and build the cycle, if necessary.

For entitlement on products that cannot be derived, default entitlement dates are supplied on a default entitlement table 1206.

The entitlement add module 1182 next writes the cycle information to the entitlement lists 1135. Tables exist for bond maturity entitlements 1208, calls 1210, factor principal paydowns 1212, interest 1214, dividends 1216 and dividend alternatives 1218. Related to those tables are two common tables: an entitlement group table 1220 and an entitlement header table 1222.

With the tables updated the subsequent action module 1178 calls the notifier module 1186 to announce to other DIR modules of the table changes if the change was critical: scheduling, start-up, and proofsheet processing. The modification module 1190 and the delete module 1192 perform in a manner similar to the add module 1182.

ii. Start-up, Clean-up Processing and Phased Distributions

FIG 236 depicts start-up and clean-up processing and phased distribution.

For stock and cash dividend entitlements, the ex-dividend date from the entitlement table 1135 is put on the start up file 1141 in the firm-payment date field. For stock and cash dividend entitlements, the start-up scheduling module 1139 will read the firm account settlement date P&B table 604 for any settled firm positions in the product. If no position is found, the start-up scheduling module 1139 will also read executed trade file records 1240 for form account trades with a projected settlement date less than the ex-date or record date depending on the product type. If either is found then the modules will set a firm-position flag on.

A batch report process routine 1242 reads the updated start-up schedule table and creates a written report 1140 listing products that are beginning an entitlement cycle. The start-up schedule file 1141 is read for products with a start-up flag set to 'Y' and a start-up date equal to the current day. The reports 1140 will note the type of entitlement, product number, description,

record date, payment date, first and last accrual dates, ex-dividend date, interim dates, rate and whether a product has clean-up position. The reports 1140 have a different format for each entitlement type.

As discussed above, start-up and clean-up processing are two totally distinct but related steps in entitlement processing.

An entitlement cycle is "started-up" normally 3 days before the record date or on the date one day preceding the ex-divident date of a security. For securities with stock and cash dividends, as a matter of security record-keeping practice, start-up occurs on a security's ex-dividend date. As part of the phased distribution scheme, firm accounts are paid all ex-date entitlements based on the projected settled record date positions held. As a part of a start-up processing, a firm ex-dividend payment report is created. This payment sheet is adjusted for activity between ex-date and record date by proofsheet adjustment functions described below. In a batch process, the start-up module reads the EASY entitlement data tables 1135 to locate products that have not. The process flow for the start-up scheduling subsystem is depicted in FIG 23b. The processing to create the notification table 1141 is performed in background. On an end of business day basis, the entitlement lists 1135, described above, are read to locate products that have not already been started-up and whose start-up date is equal to or less than today (if today is followed by a weekend or holiday these days are included).

For the products selected, a start-up scheduling module 1234 first creates a new entry in the start up file 1141, and sets the start-up and clean-up flags and start-up and clean-up dates. The start-up file marks the data when the security was placed on the list. The clean-up flag denotes how long the clean-up process (described in detail below) will be performed on that particular entry.

The clean-up process, distinct from start-up, uses the start-up file 1141 to locate any security positions in a BOX or TRANSFER positions, whose products are on the start-up table 1141. Thus, where start-up's function is to create the initial start-up table, it is the function of the clean-up module to continually check from initial start-up until record date, whether there is a BOX or TRANSFER position for that security.

Using the products listed on the start-up table 1141, the clean-up module 1244 reads the P&B location files 606,612 to locate TRANSFER and BOX positions in those securities. Once those positions are collected at the end of each day, the clean-up module 1244 creates a clean-up report 1140.

A phased distribution module 1250 allocates stock and cash dividends on an ex-dividend record date basis to firm accounts. Phased distribution means processing of the firm entitlements at phase in the entitlement cycle, earlier than the customer allocation of entitlements to customer accounts. Phased distribution is a general record-keeping procedure used by securities trading firms.

The phased distribution module 1250 normally begins processing of firm account entitlements on the night before the ex-dividend date of the dividend entitlement. However, the module can be synchronously invoked during the trading day, when there has been a time-critical change to the start up file 1141.

As mentioned above, the start-up scheduling module has marked potential securities for entitlement due. The firm-payment date field for all applicable securities in the start up file 1141 has been given its ex-date. The phased distribution module 1250 searches the start-up file 1141 for records where the ex-date and firm payment date equals the current date. For all the records where ex-date and firm payment date equals the current date, the phased distribution module 1250 checks the P&B firm settlement date table 604 to determine if a position is held. Where there is a product match, the phased distribution module 1250 creates payable or receivable records to be processed by the DIR entitlement distribution module (scheduling) 1142 and the general ledger interface module 72. The updates are sent to the entitlement distribution module (scheduling) 1142 and the general ledger interface module 1254 using the generic distribution mechanism 1252 described above. For all entitlements, the phased distribution module 1250 creates record information and notifies the firm inventory module 66. As described above, the firm inventory module 66 will invoke the P&B manager module 64 to create P&B table updates. The phased distribution module 1250 also outputs to the reports on the firm ex-date entitlements created.

iii. Proofsheet Processing

Proofsheet processing module 1136 creates and reports on security entitlements due, using the entitlement cycle information created by the EASY 1134 and start-up modules 1139, and firm position data located in the P&B 62 and other files. Proofsheet processing functions enable users to gather pending entitlement information for securities actually held, such as firm position on a stock's ex-date; record date positions; call date positions (lottery results if the call is partial) and "pre-record date" positions for the securities whose record dates precede payment date by one day.

The process of creating proofsheets requires matching the general entitlement cycle data created by EASY 1134 with the actual position data maintained in the position and balance files 62. For example, record date proofsheets are created in daily batch processing by collecting the EASy record date entitlement information and matching it with position and balance file settlement positions and trade information located in the executed trade and other files. On a security's ex-date, the proofsheet processing modules captures position and balance trade-date positions 604, 602, 606 and projects the settled record date position entitlements for those pending trades.

Proofsheet data created for record date settled positions is used to create entitlement payables and receivables, as will be described below. Because those receipt and deliver functions require up-to-the-minute entitlement information, the proofsheet data can be updated by a proofsheet

adjustment and override functions. Override and proofsheet adjustment are also described full below in FIG 23d.

An overview for creating a proofsheet as of record date is shown in FIG 23c. Record date proofsheets are created at the end of a business day for the next day, during batch cycle processing.

An entitlement information gathering module 1270 begins reading the EASY entitlement information files 1135 described above searching for all EASY records with a record date of the next day. Those records are written to an intermediate log file 1274. A proofsheet matching module 1276 reads the intermediate log file 1274 and attempts to match those records against the P&B database settlement date position files 610, 608, 612. The matching module 1276 will exclude all position and balance matches when the securities are either in a (box), safekeeping (SFK), or transfer (TRANSF) position. As a matter of securities recordkeeping practice, securities in safekeeping, box and transfer will not render any entitlements for a firm to process. All entitlements for those security positions go to the customer -- there is nothing that a firm needs track.

The matching between the position and balance database account positions and the EASY entitlement information forms the basis of the record date proofsheet. Records on the matches are written to a proofsheet file 1282.

For certain stock positions such as fails, stock borrows, stock loans, and repos, the transaction

processor of the present invention maintains detail records. The details are contained in files such as the clearance fail activity file depicted in FIG 23c at 1066. The transaction processor incorporates those details into its proofsheets, making them very useful to users. A detail collection module 1284 asynchronously access the clearance module fail 1064 and fail activity 1066 files, and the position and balance memo file 614 for "repro", and "stock borrow" and "loan" positions. The gathered details are written to a proofsheet detail file 1289. When proofsheet reports are generated, the proofsheet database details are included.

Another aspect of the proofsheet processing process is the creation of due bills. As a matter of securities practice, entitlements accruing to trades that are in a fail status on record date cannot be given to the beneficial owner. On record date, the owner is the original security holder -- any entitlement due will go to the original owner, regardless of the fact that the trade will subsequently clear, albeit after the original settlement date. To permit the beneficial owner to receive the entitlement that it would have received had the trade settled as planned, security firms will as a matter of practice, send a due bill along with the trade when it finally settles. Thus, certain trades require a "due bill" upon outgoing delivery and certain purchase trades require a due bill receipt acknowledgment upon incoming delivery. The due bill module 1290 creates a file 1298 to track the due bill entitlements and insure that as a stock clears the due bill is sent or received.

The trade entry modules 48, described above, sets a due bill indicator on the securities that require a due bill should the trade fall. The due bill module 1290 accesses the proofsheet table 1282, searching for trades whose failed status will require a due bill.

For each pending trade that needs due bill processing, other program modules are invoked to calculate the amount of the due bill 1292 and determine the due bill type 1294.

A due bill calculation module 1292 is invoked to obtain rate and other information from the EASy entitlement database files 1272. In order to calculate a due bill, different rates are used, depending upon the entitlement type.

The determine due bill type module 1294 is invoked to determine the type of due bill required, promissory note or due bill check, for each associated trade. The module makes that determination by comparing the projected settlement date of the trade with the payment date of the entitlement. The due bill module 1290 updates the proofsheet file 1282 with the results of the calculation. The module 1290 also updates the detail file 1289 and to a due bill file 1298. Due bill amounts are also sent to the clearance module 52.

A create proofsheet module 1295 read the data collected in the proofsheet table 1282, the due bill file 1298 and the proofsheet detail file 1289 and combines them with the proofsheet intermediate file 1282 to create a proofsheet report 1296. The

create proofsheet module 1295 sums the proofsheet report records in a proofsheet header file 1297. Corresponding details remains in the proofsheet detail file 1289.

iv. Proofsheet Adjustment

From record date to the date of entitlement payment, and even beyond the payment date, changes can occur to the firm's position holdings that affect the entitlement schedule. For example, a trade could be cancelled or modified. Stock settlements can fail across a record date. Entitlement payment schedules can change. Stock dividends can be rescheduled, cancelled, or increased. A company can declare a spurious stock split. The proofsheet module of the present invention maintains accurate and up to the minute proofsheet information by correcting the record date proofsheet with update information. The process flow for the proofsheet adjustment procedure is depicted in FIG 23d.

Trade and settlement activity 1300 is sent from the minicomputer environment 34 to the mainframe environment 36 through the store and forward module 42, as described above. On the mainframe side, the store and forward module 41 copies the data into an adjustment process storage table 1306 and the store and forward notification module 46 triggers the subsequent processing by writing a message into a queue 1307. Changes in trade date, trade quantity, process date, projected settlement date, clearance date, clearance quantity, due bill indicator and amount, will be part of the data provided.

An adjustment driver module 1308 is triggered by the notification module message to process all trade and non-trade adjustment information. Once triggered, the adjustment driver module 1308 invokes a pre-processing module 1310 to read all the transaction records in the adjustment process table 1306. The pre-processing module 1310 attempts to indicate off-setting transactions to eliminate record breaks in later adjustment processing. For the records to be processed, the pre-processing module 1310 returns control to the driver 1308 with information concerning the adjustments needed.

Update information can mandate one of four general types of updating. Trade actions, such as cancels and corrects or failures can mandate adjustment to current entitlement payment (distribution), if the entitlement payment date has not occurred, and adjustment to post distribution cycles if entitlement payment has occurred. Product master database updates or late breaking financial news can necessitate the need to make immediate changes to the product entitlement cycle schedule, and subsequent updates to the proofsheet balances.

The driving routine will invoke one or more asynchronous processing modules 1312, 1314 and 1316 to handle each adjustment situation.

A current proofsheet cycle adjustment module 1312 is invoked by the driver module 1308 after it has determined that the cycle status is in a pre-distribution phase and that the change affects a firm, customer or location position prior to payment. For each adjustment record, the current

proofsheet adjustment module 1312 is involved to either recreate the entire proofsheet or update a part of it.

A proofsheet recreation module 1320 extracts new position and balance positions from the position and balance database 62, applies all trade and non-trade activity to updates the position, update the cycle status and creates an adjustment transaction to update the proofsheet table 1282. An entitlement record date change is an example of a charge that would require recreation of an entire proofsheet. Record of proofsheet adjustment is maintained in a proofsheet adjustment file 1323.

An adjust proofsheet module 1324 handles changes that do not require major changes to the proofsheet. Single trade cancel and correct information such as the correction to the amount of securities purchased is an example of a change that would affect only a position on the proofsheet. The update proofsheet module 1324 would change and create an adjustment transaction to update the proofsheet database file and the proofsheet detail file. Record of the adjustment is also kept in a proofsheet adjustment file 1323.

The adjustment driver module 1308 invokes a past-cycle adjustment module 1314 to make trade changes, based on adjustments to past proofsheet data in the proofsheet file 1282. The past-cycle adjustment module 1314 will create a new proofsheet file entries 1282, 1289 as needed, create an updated entry for an existing position, invoke the due bill module 1290 to create a new promissory note or check and update the proof adjustment file 1323.

Entitlement changes received from the product master database will sometimes require proofsheet adjustment. When a product entitlement update is encountered, a pre-processing module 1326 to determine the criticalness of the change, according to some specified criteria. The preprocessing module 1326 will first determine the type of change that has been made. For example, an adjustment may be required as a result of a late dividend announcement during the days' trading. A product classification tree 1328 is used to categorize product type charge by importance.

If there is no immediate need to make the product master update, the criticalness module 1326 sends the record to the batch 1171 file for overnight processing by the entitlement announcement processing module 1134 as described above. However, if a critical update is required, a EASY file update module 1338 will first correct the EASY files 1135 and invoke the current proofsheet adjustment modules 1312 or the post-distribution proofsheet modules 1314, as needed.

v. Distribution

The distribution module 1142 of DIR makes allocations of the entitlements to customer and other accounts within the firm. Distributions are in the form of trader and customer position adjustments, checks, wire payments and stock payments. Distributions are made on a specific date, as determined by the type of entitlement and the beneficial owner.

The process flow for the distribution module 1142

is shown in FIG 23e. A distribution module 1340 creates the distribution records and store them in an entitlement history table 1346. The distribution records are based on information from the schedule entitlement transaction tables 1143, the proofsheet header file 1297 the proofsheet detail file 1289 and the proofsheet schedule file 1282. The distribution records will carry the customer and account name, the entitlement-type, the amount of money or stock due, and the projected effective date of payment. In most cases, the effective payment date will be the actual payment date. However, the transaction processor of the present invention permits phased distribution of entitlements. As a matter of securities practice, traders may be credited with entitlement distributions on dates different from customers or security beneficiaries. The distribution module 1340 will create two separate distribution records for the entitlement history table 1346.

The entitlement history table 1346 contains a history of all entitlement distribution information. However, updates to the file are first written to a one-day table 1348, containing all distribution records that were collected during the previous night's batch processing. A DIR notification module 1349 feeds the one-day table's 1398 contents to other transaction processing modules, the firm inventory 66, P&B 64 and customer accounts 68 modules depicted as 1343 and 1344.

vi. Receipt and Reconciliation

The DIR receipt and reconciliation module 1148 manages the movement of all entitlement monies and

securities. The DIR receipt and reconciliation module 1148 interfaces with the cash management system module 54, the position and balance module 64 firm inventory module 66 and customer accounts module 68 to process entitlement cash flow to handle entitlement security movement. Thus, the movement of entitlements is integrated with the main cash and security flow modules of the present invention.

There are two basic functions to the receipt and distribution module 1148 of the present invention. The first function is to set up payable and receivable records for the entitlements. The second function is to record the receipt or remittance of entitlements.

The process flow for creating payable and receivable entitlements (and then tracing their remittance) is depicted in FIG 23f. Using the records from the schedule entitlement history table 1346 and the one day table 1348, a receipt and reconciliation processing module 1350 creates payable and receivable records for the entitlements listed. The records are written to a DIR payable and receivable file 1352.

Payment and receivables are maintained for firm and customer accounts and streetside location accounts in a manner similar to the account and location files are maintained in the P&B tables 62. Streetside and accounts-side payable and receivable entitlement records must offset. A link entitlement file 1354 contains cross-references from the entries in the payable and receivable file 1362 with entries in the proofsheet detail file

1289.

Copies of all DIR payable and receivable file records 1362 pertaining to cash entitlements are sent to the cash management system module 54, for integration into the CAMS system-wide integrated payable and receivable file 56 (see FIG. 3) described above.

All DIR payable and receivable records for quantities of security entitlements are sent to the position and balance module 64. To make the records available to P&B, the receipt and reconciliation module 1350 sorts though the DIR one-day table 1348 and feeds all security quantity records to the position and balance settlement files on the night before entitlement payment.

The receipt and reconciliation module 1350 performs a number of reporting functions. A due bill production module 1364 selects payables that require a due bill and gives information to a printing module for due bill printing. An external data interface module 1362, notifies banks of the need to present securities or coupons for interest payment.

FIG 23f also shows the process flow for the receipt of entitlements. As cash funds are received, the CAMS module 1356 makes record keeping updates and subsequently notifies the DIR module 70 of the receipt. Typically, the payment is a lump sum payment that must be allocated to the various accounts on the entitlement history table 1346. Initially, the DIR module 70 is notified via the store and forward modules 41, 42 of the CAMS module

cash receipt. A matching module 1359 receives the records and updates the DIR payable and receivable files 1352.

The matching module 1359 then allocates the entitlement receipts to the various parties by cross-referencing entries in the payable and receivable file 1352, with entries in the link processing file 1354. The allocations of entitlements to accounts can be based on an appropriate formula. The updates are made by the matching module 1359 to the distribution tables, first to the one-day table 1348 then to the history file 1346. The DIR notification module 1349 notifies other transaction processor modules firm inventory 1343 and margins 1344 of the distribution updates.

8. General Ledger Interface

The general ledger interface module (GLI) 72 depicted in FIG 3 is the accounting core of the present invention. GLI's central function is to systematically update the firm's general ledger with all transaction activity. On an on-line, real-time basis, GLI accepts the transaction events and, at the end of the processing day for each branch of a securities trading firm, automatically creates accounting records that reflect transaction activity. The records are netted together to create the summary journals that update the general ledger. A reconciliation process is designed to assure that the processing updates to the transaction processing modules are accurately reflected in the general ledger. On-line inquiries provide the ability to review control account

postings and "as of" postings. Further, depending on posting date, GLI provides the ability to selectively post "as of" prior period activity processed in the current period, to the prior general ledger accounting period.

The process flow of the GLI module 72 is depicted in FIG 24. GLI has two process phases: on-line - during the transaction day - and over-night batch processing. During the day, the GLI module collects reports of transaction events from other systems and provides edits. In batch the GLI module 72 classifies those records, creates additional offsetting account entries, formats them and creates GLI detail records. The detail records form the basis for the journal entries to a firm's general ledger.

The processing begins as the transaction processing modules (e.g. 1370, 1372) update their files and send those records to a GLI automatic journal processing module 1374, 1376. The forwarded record contains information needed to create GLI detail postings to a GLI detail file 1410, including a source module information and position information (e.g., product number, trading account, and inventory type).

The automatic journal processing modules 1374, 1376, existing both on the mainframe and the minicomputer environments, function as a book-keeping mechanism to take the raw data from the source systems to create general ledger detail postings. Automatic journal processing modules 1374, 1376 perform two basic functions using the raw data: classify and uniquely identify the

incoming record. A second detail explosion module creates the general ledger entries 1408.

The automatic journal processing modules 1374, 1376 perform classification functions by accessing data from the general reference databases 76, 77 to create ledger destination codes that will group each transaction event entry in appropriate ledger journal sub-entries. A product classification tree 1386, 1388 groups all the security products by their journal entry destination. Product classification modules 1379, 1377 traverse the trees to obtain the journal entry destination for each record. Further product information used to create destination codes is found in the product master general reference database (206 in 76, 77). The trading account master database depicted (204 in 76, 77) enables the automatic journal processing modules 1374, 1376 to translate an account number into trading desk, office, and company journal sub-heading. Input information contained on the record helps make up the remainder of the general ledger account record entry.

With the records classified and identified in a format for further processing, the automatic journal processing modules 1374, 1376 write the records to an intermediate log file 1390. In addition, a file 1392 is maintained keeping running totals to project the end-of-day account balances of the transactions as classified.

The mainframe-based automatic journal processing module 1376 writes to the intermediate logs 1390, 1392 directly. The minicomputer-based automatic journal process module 1374 outputs to the store

and forward log 43. The store and forward modules 41, 42, as described above, writes the data to a massive storage table 1391. The store and forward notification module 46 awakens a GLI mainframe environment interface module 1395. To retrieve the data from the massive storage table 1391 and add it to the GLI intermediate log files 1390, 1392.

As a matter of general accounting practice, accounting books are kept on a double entry basis, (credit and debit) and book entries balance. Accordingly, each transaction input sent to GLI from a transaction processing module (such as trade entry 48, DIR 70) will require at least two GLI accounting entries. Some transaction input can contain enough data to create the multiple GL entries. The multiple entries are created from the GLI classified intermediate records 1390, 1392 in the detail explosion phase, described below.

Other transaction input do not contain enough information to create an entry and offsetting entry. These entries must either be created or the transaction data must be listed to other transaction data to create the link.

For transaction events that will not translate into both the entry and offsetting entries, the automatic journal processing module 1374 and the GLI minicomputer interface module 1395 will trigger a control account module 1394 to create the offsetting entries needed to accurately place the transaction event information into the general ledger.

Depending on the transaction event, an offset post-

ing could be either 1) a system to system control account linking entry; 2) an intercurrency control account entry; 3) a transaction processing system to non system suspense account entry; or 4) a manual suspense account entry.

Control accounts are general ledger accounts used to establish accounting links between the flow of information between two transaction processing modules that independently pass GLI updates for the same transaction. Transaction processing modules create a general ledger postings that are comprise only one side of the accounting entry. The control account module 1394 creates control account postings as the offsets to those otherwise one-sided entries. For example, when securities are sold, the trade-entry modules 48 will create an accounting debit trade receivable journal entry, and the control account module 1394 creates an offsetting credit to the control account entry. The firm inventory module 66 will initiate a credit entry to inventory. GLI creates with the control module 1394 another offsetting debit entry to the control account causing the net effect of the entries in the control account file 1396 to balance. On the other hand, if both sides of an accounting entry are created by the same transaction process input, in the transaction processing module, no control account record is created.

Creation of intercurrency control account records initiated by the control account module 1394 to offset native, base, and consolidated currency ledger entries. Within the individual ledgers, each side of the intercurrency account is posted by

a different module. For example, the debit to an inventory journal and an offsetting credit to an intercurrency account journal is initiated by the firm inventory system, while the credit to a trades payable journal and an offsetting debit journal to the intercurrency account is initiated by the trade-entry module. Assuming that both systems pass their side of the entry to the GLI module, the intercurrency account within the base and consolidated ledgers should net to zero. The base and consolidated intercurrency account acts as a control account to verify that both sides of an inter-system data flow are passed and properly posed by the GLI module.

When one side of an entry is initiated by a transaction processing module and the other side of the posting is a non-transaction activity, GLI posts the transaction processor entry to a regular general ledger account. Records are extracted from a GLI detail file 1410 during the nightly batch cycle to be described below. This file contains the information required to update the non-transaction account accordingly.

Mutual suspense accounts entries are created by the control account module 1394 when a transaction processing module cannot match an entry to a payable or receivable by the end of the business day. The feeding source transaction processing module updates its balances and calls the GLI automatic journal process module with a "special business event" record. The automatic journal process module 1376, will invoke the control account module 1394, create an entry to update the account which corresponds to the source system

balance, and then post the "unknown" payable/receivable to a suspense account. For example, if at the end of the processing day the CAMS module is unable to match a dividend payment to a corresponding receivable on the integrated payables and receivable file, it posts an "unknown" item on the IPR file. Simultaneously, DIR passes the update to GLI with a specific business event code and GLI creates a manual suspense account posting to reflect the unknown receivable.

Overnight batch processing begins with an entry reclassification function.. As described above, during the processing day, the GLI module uses the account cross-reference table 1378, 1380 the product classification trees 1386, 1388 and the trading account master database 204 to translate the transaction processor source module data into components of the general ledger account key. Because those database files can be updated during the day, general ledger classifications created for the previous days may no longer reflect the current classifications. To insure the integrity of the general ledger, a GLI reclassification process module 1398 updates any GLI intermediate posting of control account file that should be affected by a change in the database.

In batch mode, the reclassification process re-builds the general ledger account records for the projected source system balances, using the updated current end-of-day account cross-reference table and the updated centralized databases 44. The reclassified balances are compared to the originals. The re-classification module 1398 will change the classification of any entry and if

necessary its affected control account records 1396. The reclassified projected closing balances are written to a reclassified closing balance file 1402 and the reclassified GLI records are written to a reclassified intermediate file 1404.

In batch mode, the reclassification module 1398 will also rebuild the general ledger account file records for yesterday's transaction processor module balances, using data stored in a yesterday's balance file 1406. Every classification change to those files will create a new transaction processor module detail 1392 record to correct and create offsetting entries for the mistake. The reclassification module 1398 will update the general ledger balance file by reversing the balance out of the old general ledger account and applying it to the new general ledger account.

A detail explosion module 1408 takes the now accurately classified and identified source records and populates them into as many journal entry details and offsetting entries as necessary to properly update the general ledger.

Explosion of the GLI intermediate file 1390, 1392 updates is accomplished by accessing account cross-reference tables 1378, 1380. The account cross-reference tables comprise table structures that contain codes that will determine functions to be performed on the input. Each source module record is mapped to a three-digit general-ledger code kept on the account cross-reference tables 1378, 1380. That code is used to clarify the entries that will be created from the raw data to appropriate journals on a firm's general ledger.

Associated on the table account cross-reference tables 1378, 1380 with each three-digit general ledger journal code is a corresponding three-digit code for the offsetting journal entries which will have to be created from the raw transaction data. The automatic journal process module 1374, 1376 select the correct code based either on the type of business event or the identification code of the transaction processing module input.

The detail explosion module constructs a unique reference key for each record, consisting of three distinct parts, for each detail record. Using source system supplied information, GLI detail explosion module 1408 constructs the reference key using the source system reference number, the matching system's reference number, and a sequential numerical suffix which is incremented by one each time a detail posting is created. The reference number is an important tool that allows users to research transaction information and accounting entries in GLI and back to the transaction processing module supplied data. All detail records are written to the GLI detail file 1410.

For all offsetting position in the control account file 1396, a GLI control account matching module 1412 attempts to match control account entries. The control account matching module 1412 totals all control records in control account unmatched file 1396 for a transaction event. If the total of the entries is zero, the control account entries are considered "matched." In the GLI detail file 1410, offsetting entries are marked. Matched control records are also written to a control account

balance file 1414. However, when the control account unmatched file 1396 does not net to zero, the entries remain in unmatched status.

As detail file records are created, the detail explosion module 1408 encounters "as of" records that require special handling. "As of" entries are entries that have arrived on the current day, but whose effective date is set to an earlier date. As a matter of accounting practice, "as of" records can be posted in certain cases to either the current accounting period when the "as of" was received or the immediately prior period.

Three program modules facilitate "as of" processing: an "as of" adjustment module 1416, an "as of" cancellation module 1418, and an "as of" inquiry 1420 module.

"As of" input is passed to the GLI module as transactions with "as of" dates. Any "as of" transaction passed to the GLI module on the first two business days of the current month's effective date are automatically posted to accounting journals for the current period and then set up as "as of" reversal postings to the journals of the previous month by the automatic journal module 1374, 1376. The detail explosion module 1408 stores the prior period adjustment on an "as of" file 1422. The effect of the reversal within the firm's general ledger is to reverse the postings from the current period and apply them to the immediately prior period. An "as of" inquiry module 1420, provides on-line review of the automatically prior period posted "as of" adjustments.

Any "as of" transaction processed after the second business day of the current month (notational "as ofs") are automatically applied only to the current period on the GLI detail file 1410. With the "as of" inquiry module 1420, the user may review the details of the notational "as of" posting on-line and select those items which should be applied to the prior period. An "as of" adjustment module 1416 then creates the appropriate detail postings to reverse the item out of the current accounting period and apply them to the immediately prior period. The "as of" prior period reversal entries are maintained on a GLI "as of" file 1422. An "as of" cancellation module 1418 provides the facility to cancel notational "as ofs" that were manually posted to the prior period. The effect of the cancellation process within the general ledger is to reinstate the original "as of" posting to the current period.

After the detail records have been classified, identified and exploded, a summation process module 1440 reads the detail file 1410 and sums the journal postings to create summary journals. The summary journals are used to update the general ledgers 1442. Non-trade related accounting details are also summed by a separate module 1444 to create a non-trade related posting file 1446. For audit trail purposes, each summary posting to the general ledger maintains a link to its supporting details through reference key table (1447, 1448) entries created by the summary processing modules 1440, 1444.

A reconciliation module 1424 verifies that the daily input updates are accurately reflected in the

ledger postings. Furthermore, the reconciliation module 1424 verifies that the GLI module 72 will properly apply correct updates to a firm's general ledger.

The reconciliation module 1424 is scheduled to run in batch at the end of the processing day, when the closing balance files of every interfacing transaction processing module have been sent. The transaction processing modules that reside on the minicomputer will use a notification function to inform the GLI module when their balances are closed on any given day.

The reconciliation module 1424 of the present invention comprises three basic reconciliation attempts. First, the reconciliation module 1424 determines whether the day's projected closing balances, are equal to the system's actual closing balances. Projected closing balances are calculated by adding the daily posting to the GLI summary files 1445, 1446 to the previously stored opening balances. The summations are created on a general ledger account key basis and stored in a projected closing balances file 1442. An "actual" closing balances file 1430 contains data summed by the reconciliation modual 1424 as originally sent from transaction processing modules.

The projected and actual balances are separately summed on a general ledger account key basis. They are then compared to each other to detect differences. For the differences discovered by the reconciliation module 1424, a reconciliation exception report 1432 is printed containing the general ledger account keys involved in the break,

the respective balances, their differences, and the processing date. The breaks can be researched at the trade level, by viewing the contents of the detail file 1410. The reconciled, reclassified closing balances are written to a reclassified closing balance 1438.

The reconciliation attempts a second reconciliation between data in the projected closing balance file 1402 and data in a general ledger balance file 1434. This reconciliation is performed daily to compare the source system balances to their general ledger equivalents. This ensures that the general ledger is receiving the GLI summary postings properly and that no erroneous general ledger manual entries have been made.

If any differences are discovered, they are reported in an error report by the reporting module. This report contains the general ledger account key, the respective balances, the differences between the balances, and the processing date. This information is provided to support research of the breaks.

The reconciliation module 1424 performs a third "as of" reconciliation every month to ensure that the general ledger system is properly reflecting all "as of" activity. The reconciliation is performed after the "as of" posting process is closed (as a accounting matter) for the prior accounting period's "as of" adjustments. The reconciliation module 1424 creates a projected "as of" net change file 1436 which combines the closing periods balances on the last day of the previous month with all prior period "as of" adjustments applied.

Those adjusted balances are compared, on an account key basis, to the general ledger balances for the last day of the previous month 1431. If any differences are discovered during the comparison, an "as of" reconciliation error report is printed by the report module 1432, containing information to help trace the break's origin. The general ledger account key, the respective balances, the differences, and the processing date are all printed to the report.

E. Implementing the Transaction Processor Feature Modules

The transaction processor of the present invention can be implemented using any programming language that is supported by the operating system of the environment in which the program module resides. In the present invention, the Seer Technologies Inc. rules-based language and the computer-aided software engineering facility sold under the trademark of "High Productivity System" or "HPS" was employed in implementing the transaction processing modules. For background information on the HPS rules-based language and CASE facility, the reader is referred to the co-pending U.S. application serial number 444,060, filed November 30, 1989 entitled, "Computer-Aided Software Engineering Facility," that is hereby expressly incorporated by reference.

What is Claimed is:

1. A computer system for processing transaction information, which comprises

a. a transaction information entry module including:

i. a first processor having an input to receive information relevant to a plurality of individual transactions and for generation of individual transaction records, one corresponding to each one of the plurality of individual transactions, and

ii. a transaction record file coupled to said first processor for input and indexed storage of each one of the individual transaction records;

b. a transaction record processing module coupled to said transaction record file and arranged to controllably access eac one of the individual transaction records from said transaction record file, said transaction record processing module including:

i. a second processor for correlating each one of the accessed transaction records to individual transaction account information and cumulative transaction accounting and inventory information, and

ii. a preselected set of individual account and cumulative accounting and inventory files coupled to said second processor for input and indexed storage of correlated information to update and record the individual transaction account and cumulative transaction accounting and inventory information as a function of the individual transaction records;

c. a communication module coupled to each of said transaction information entry module and said transaction record processing module to transmit notification communications between said transaction information entry module and said transaction record processing module, the notification communications including notification of storage of individual transaction records in said

transaction record file; and

d. said transaction record processing module being responsive to the notification communications to access the individual transaction records from said transaction record file, asynchronously to operation of said transaction information entry module, such that entry of information relevant to each of the plurality of individual transactions and correlating processing and update and recordation of individual transaction account and cumulative transaction accounting and inventory information, as a function of the individual transaction records, is processed in an on-line operation.

2. The computer system of claim 1, further comprising:

a. a preselected set of reference data bases containing attribute information relating to data elements input to said first processor in connection with the plurality of transactions;

b. said first processor being coupled to said set of data bases for accessing the attribute information during generation of

the individual transaction records so as to include relevant attribute information in each one of the transaction records.

3. The computer system of claim 1, wherein said first processor and said second processor together comprise a central processing unit having a multi-tasking capability.

4. The computer system of claim 1, further comprising a computer network including a plurality of personal computers and at least one main data processing facility coupled to one another and wherein:

a. said transaction information entry module includes said plurality of personal computers for input of the information relevant to the plurality of individual transactions; and

b. said first and second processors together comprise said at least one main data processing facility in a multi-tasking mode of operation.

5. The computer system of claim 4, wherein said at least one main data processing facility includes a fault-tolerant mini-computer and a

mainframe computer cooperatively operating with one another as said first processor and said second processor.

6. The computer system of claim 1, wherein said transaction record processing module comprises independently, asynchronously operating sub-modules, each operating to receive the notification communications, access said transaction record file and perform correlating processing of each one of the transaction records in respect of preselected portions of the individual transaction account and cumulative transaction accounting and inventory information, respectively, and to update preselected ones of said set of individual account and cumulative accounting and inventory files.

7. The computer system of claim 6, wherein each one of said sub-modules accesses a preselected portion of each transaction record, the preselected portion being relevant to the respective portion of the individual account and cumulative transaction accounting and inventory information for which said sub-module performs correlating processing.

8. A transaction processor for processing input data comprising information on a plurality of individual executed transactions, the transaction processor comprising:

a. a first central file containing general product and market data related to transactions;

b. a second central file containing executed transaction records;

c. a result file for storing cumulative indications of expected subsequent business events relating to the plurality of individual executed transactions;

d. a transaction input module coupled to said first central file and said second central file, to receive the input data, process the input data using data from said first central file relevant to the plurality of individual executed transactions, to create a plurality of individual processed executed transaction records, one corresponding to each of the plurality of individual executed transactions and each including general product and market data relevant to one of the plurality of individual executed transactions, and to write each of the processed executed

transaction records in said second central file;

e. a transaction processing module being coupled to said second central file to access each of the executed transaction records from said second central file being coupled to said result file to update the cumulative indication of executed subsequent business events as a result of the plurality of individual executed transactions; and

f. a communication module coupled to each of said transaction input module and said transaction processing module to transmit notification communications between said transaction input module and said transaction processing module, the notification communications including notification of storage of individual transaction records in said second central file and to invoke said transaction processing module to access executed transaction records from said second central file and to update said result file.

9. A module for storing data relating to executed transactions, said module comprising:

a. a first database containing general product information and routines to perform

general transaction related calculations on the data relating to a plurality of executed transactions;

b. a second database to store transaction records;

c. a transaction processing module to receive the data relating to each of the plurality of executed transactions, being coupled to said first database to access and use general product information and routines to validate and embellish the data related to each of the plurality of executed transactions, for creating a plurality of executed transaction records, one for each of the plurality of the executed transaction records, and being coupled to said second database, to store each of the executed transaction records at a respective preselected location in said second database; and

d. a notification module to output message primitives each comprising an identification of the executed transaction records and the preselected location in the second database of the executed transaction records.

10. A module for processing transaction input

comprising data on executed transactions, received from more than one transmitting locations, the transaction input module comprising:

a. a database containing general product information and routines to perform general transaction related calculations on the input data;

b. a database to store processed transaction input;

c. a file to store processed transaction input;

d. a first input processing module to receive the transaction input data from a first selected one of the more than one transmitting locations, process the data, and store the transaction data in said database, processing comprising validating the data against the general product information, embellishing the input data with general product information and calculating transaction related values;

e. a second input processing module to receive transaction input data from a second one of the more than one transmitting locations, process the data, and store the transaction data in said file, processing

comprises validating the data against the general product information; and

f. a breaksheet processing module to match processed transaction data in said file against processed transaction data in said database and to create a breaksheet report, the breaksheet report comprising dated instances where data in said file has no match against data in the said database.

11. A cash management system module for maintaining all cash flow movement related to executed transactions, said cash management system module comprising:

a. a transaction information entry module including:

i. a transaction processor having an input to receive information relevant to a plurality of individual transactions and for generation of individual transaction records, one corresponding to each one of the plurality of individual transactions, and

ii. an executed transaction record

file coupled to said first processor for input and indexed storage of each one of the individual transaction records, each record containing data on an executed transaction including cash due on an executed transaction;

b. a payable and receivable file for storing payable and receivable data created to represent cash due on executed transactions;

c. a cash activity file containing records detailing events related to cash flow movement;

d. a cash totals file containing current cash balances in at least one cash account;

e. a payable and receivable creation module arranged to access records from said executed transaction record file, process the accessed records to create data representative of the cash due on each of the executed transactions and store data in said payable and receivable file;

f. a payable and receivable update module arranged to accept data input on cash flow

movement and process that data to update the records in said payable and receivable file, update the cash balances in said cash totals file and create a record of the cash movement in said cash activity file, so that all cash due relating to executed transactions is cross referenced to cash flow movement;

g. a communication module coupled to said transaction entry module and said payable and receivable creation module to transmit notification communications between said transaction entry module and said payable and receivable creation module, the notification communications including notification of storage of individual transaction records in said executed transaction record file;

h. said payable and receivable creation module being responsive to the notification communications to access each of the individual transaction records from said transaction record file, asynchronously to operation of said transaction information entry module, such that entry of information relevant to each of the plurality of individual transactions and correlating processing and update and recordation of individual transaction account and cumulative transaction accounting and inventory information, as a function of the individual

transaction records, is processed in an on-line operation.

12. The cash management module of claim 11, further comprising a module to access said payable and receivable file, said executed transaction file, said cash totals file, and said cash activity file to create reports on current bank account totals and projected cash movement and totals.

13. A module arranged to track product holdings for an organization, holdings comprising products purchased in a transaction on a transaction execution date and to be paid for on a transaction settlement date, said module comprising:

a. a plurality of files to store data on the holdings as of transaction execution date and transaction settlement date, the files by transaction execution date comprising an account file indicating product ownership and a location file indicating the locations where account file products are actually located, the files by transaction settlement date comprising an account file indicating product ownership, and a file for the locations where the account file products are actually located;

b. a module to accept transaction data

input concerning executed transactions and product movements, said module arranged to create entries to the transaction execution date and settlement date account and location files to track the execution of transactions and movement of transaction products; and

c. a module arranged to read each record in said transaction execution date location file and said settlement date location file, match each location entry against a counterpart entry in the transaction execution date or transaction settlement date account files, create a dated record break entry in the corresponding file when a counterpart entry is not found and create a report, the report comprising entries on each account file that has no counterpart entry in said location file and where the corresponding dated record break was made.

14. A module arranged to track the liquidation of product holdings for an organization having customer accounts, holdings comprise products purchased in a transaction on a transaction execution date that are to be paid for and delivered on a transaction settlement date, said module comprising:

a. a plurality of lot files to store data on product account holdings, each lot file

being arranged in a lot liquidation list, the lot liquidation list comprising records on account holdings ordered according to a preselected strategy for liquidation by sale;

b. said lot files arranged to created liquidation lots as of transaction execution date and as of transaction settlement date, the files by transaction execution date comprising a file for account lot liquidation by list, a file for holdings that have been liquidated from the lot liquidation lists, and a file for cancelled, corrected and late additions to the lot lists, the files by transaction settlement date comprising a file account lot liquidation by list, a file for holdings that have been liquidated from the lot liquidation lists, and a file for cancelled, corrected and late additions to the lot lists;

c. a module to receive input, input comprising executed trade data and product movement data, and process that data to create updates to the lot liquidation files by transaction execution date or settlement data according to the lot liquidation strategy;

d. a plurality of files to store data on the holdings as of transaction execution date

and as of transaction settlement date, the files as of transaction execution date comprising a file for account holdings, the files as of transaction settlement date comprising a file for account holdings;

e. a module arranged to read each record in the transaction date account file and create a corresponding record in the settlement date file, and create lot liquidation entries for the settlement date lot liquidation files; and

f. a module arranged to read each record in the transaction date lot liquidation files and the settlement date lot liquidation files, match each location entry against a counterpart entry in the transaction execution date or transaction settlement date account files, create a dated record break entry in the corresponding file where the match was expected and create a report, report comprising entries on each file record that does not match and where the corresponding dated record break was made.

15. A clearance module arranged to process input, input comprising data on executed transactions, the clearance module comprising:

a. a transaction information entry module including:

i. a transaction processor having an input to receive information relevant to a plurality of individual transactions and for generation of individual transaction records, one corresponding to each one of the plurality of individual transactions, and

ii. an executed transaction record file coupled to said first processor for input and indexed storage of each one of the individual transaction records, said executed transaction record file containing a first record on each of a plurality of executed transactions, each transaction including a purchase and sale of a product;

b. a clearance main file;

c. a first clearance module arranged to access each first record from said executed transaction record file, and process each first record to create a second record

denoting the expectation of the receipt and delivery of the product relating to the respective one of the plurality of executed transactions, and writing each second record to said clearance main file;

d. a clearance line-up file;

e. a second module arranged to access said clearance main file to select certain ones of the second records depicting executed transactions that are expected to have receipt and delay of a respective product during a certain business day and write the selected second records to said clearance line up file;

f. a third module arranged to receive input concerning the settlement of the plurality of executed transactions, settlement input comprising data relevant to whether the product of the executed trade was received or delivered;

g. a clearance detail file;

h. said third module arranged to process said input concerning the settlement of executed transactions, processing comprised of updating each of the plurality of records

in said clearance main file corresponding with each data input, storing each data input in said clearance detail file;

i. a communication module coupled to said transaction entry module and said first clearance module to transmit notification communications between said transaction entry module and said first clearance module, the notification communications including notification of storage of individual transaction records in said executed transaction record file; and

j. said first clearance module being responsive to the notification communications to access each of the individual transaction records from said transaction record file, asynchronously to operation of said transaction information entry module, such that entry of information relevant to each of the plurality of individual transactions and correlating processing and update and recordation of individual transaction account and cumulative transaction accounting and inventory information, as a function of the individual transaction records, is processed in an on-line operation.

16. The clearance module of claim 15 wherein said second module is coupled to and arranged to output to a

CPU-linked bank processing module.

17. The clearance module of claim 15 further comprising:

a. a pair up file; and

b. a third module arranged to access said clearance main file and pair related transactions that are expected to settle, creating a single paired record in said the clearance main file and writing the components of the pair into said pair up file.

18. The clearance module of claim 15 further comprising:

a. a failed file; and

b. a fourth module to access said clearance main file and said line up file and extract transactions that failed to settle on their given settlement date, creating a failed transaction record for each fail and writing each to said fail file.

19. A entitlement module arranged to track the receipt

and payment of entitlements related to products bought and sold in plurality a transactions relating to a plurality of individual transaction accounts, entitlements comprising dividends, interest and redeemables related to the products, said module comprising:

a. a database of general product entitlement information;

b. an entitlement update module coupled to the general product entitlement information database, arranged to receive information on entitlements and update said general product entitlement database based upon the information on entitlements;

c. a database of executed transaction information including information on products bought and sold and respective individual transaction accounts;

d. an entitlement announcement file;

e. an entitlement announcement module arranged to create entitlement schedule lists using the data in said general product entitlement database and write the entitlement schedule lists to said entitlement announcement file;

f. a proofsheet file;

g. a proofsheet creation module arranged to access said product entitlement schedule file and said database of executed trades and to create proofsheet records indicating entitlements due on products bought and sold in respect of individual transactions accounts and being coupled to said proofsheet file to write the created proofsheet records to said proofsheet file;

h. a receipt and reconciliation module arranged to accept input on entitlements paid and to process the input on entitlements paid by linking the input on entitlements paid to corresponding records in said proofsheet file;

i. said module arranged to create a list of entitlements due to the individual transactions accounts reports, claim letter; and

j. a distribution module to distribute the entitlements paid to the individual transaction accounts in accordance with the list of entitlements due.

20. The entitlement module of claim 19, further

comprising an adjustment module being coupled to said proofsheet file and to said entitlement list file arranged to accept input data concerning alterations to said proofsheet file and said entitlement list file and alter or recreate said entitlement of proofsheet file according to a preselected scheme.

21. The entitlement module of claim 19, further comprising:

a. an entitlement table;

b. a one-day table;

c. a distribution module being coupled to the proofsheet file arranged to read the contents of said proofsheet file, calculate entitlement due and distribute those entitlement in phases to a plurality of accounts, depending on type of account and type of product and being coupled to said entitlement history table write the records of entitlement due to said entitlement history table;

d. said distribution module being coupled to a one day table, write all entitlement due on predetermine days to said one-day table.

22. The entitlement module of claim 19, and claim 21 further comprising:

a. a due bill file; and

b. a module arranged to access said entitlement history table and create due bill records for each entitlement due on trades that have failed to clear on said settlement date, and being coupled to said due bill file output the records to said due bill file and also output said created records formatted as a due bill.

23. A general ledger interface module comprising:

a. a transaction information entry module including:

i. a transaction processor having an input to receive information relevant to a plurality of individual transactions and for generation of individual transaction records, one corresponding to each one of the plurality of individual transactions, and

ii. an executed transaction record file coupled to said first processor for input and indexed

storage of each one of the individual transaction records, said executed transaction record file containing a first record on each of a plurality of executed transactions, each transaction including a purchase and sale of a product;

b. a source module coupled to said executed transaction record file, arranged to output said records;

c. a reference file containing a list of entries marking ledger journal entries to be made for each of the plurality of the preselected data inputs;

d. an intermediate file;

e. a journal processing module, coupled to said source module, arranged to process said source module output by accessing said reference file and creating a record for each data input listing the ledger journal entries to be made from each data input and an offsetting record for each data input listing preselected offsetting ledger journal process entries to be from each data input, said journal processing module being coupled to an intermediate file, said journal processing

module writing said records into said intermediate file;

f. a detail file;

g. a detail explosion module coupled to said intermediate file, designed to create journal entry records for each record in said intermediate file and, said detail explosion module being coupled to said detail file, the created records written by said detail explosion module to said detail file;

h. a summary journal file;

i. a summary process module coupled to said detail file arranged to sum the journal entries according to a predetermined scheme and, said summary process module being coupled to said summary journal file, write the summation records to said summary file;

j. a plurality of general ledger files;

k. general ledger module, coupled to said summary journal file and connected to said plurality of ledger journal files, arranged to write the contents of the summary journal file to said ledger journal file according to a predetermined scheme;

l. a communication module coupled to said transaction entry module and said source module to transmit notification communications between said transaction entry module and said source module, the notification communications including notification of storage of individual transaction records in said executed transaction record file;

m. said source module being responsive to the notification communications to access each of the individual transaction records from said transaction record file, asynchronously to operation of said transaction information entry module, such that entry of information relevant to each of the plurality of individual transactions and correlating processing and update and recordation of individual transaction account and cumulative transaction accounting and inventory information, as a function of the individual transaction records, is processed in an on-line operation.

24. The general ledger interface module in claim 23 further comprising a control account module coupled to said journal processing module and invoked by said journal processing module to create an offsetting record for each data input, listing the offsetting

ledger journal entries to be made from the data input when the data input contains no data from which an offsetting ledger journal entry can be created.

25. The general ledger interface module in claim 23 further comprising:

a. an end of day closing balance file containing end of day closing transaction balance information;

b. a reconciliation module, coupled to said end of day closing balance file and coupled to said detail file, arranged to match records in said end of day closing balance file against records in said detail file, create reports on the results of the matching; and

c. a reconciliation break file;

d. said reconciliation module, being coupled to said reconciliation break file, arranged to write, in said reconciliation break file, all created records on non-matchings between records in said detail file and said end of day closing balance file.

26. The general ledger interface module in claim 23

further comprising a reclassification module coupled to a second input source arranged to reclassify entries in said intermediate file based on classification updates.

27. A notification and security system for a computer network including a plurality of network objects, network objects comprising computer terminals, users and transaction processor modules, the notification and security system comprising:

a. a database containing predetermined security and access information to establish links between a plurality of network objects on the network;

b. a plurality of interconnected routers, routers connected to transaction processor module objects and terminal objects;

c. a plurality of queues, each said queue comprising a memory, each queue coupled to a respective one of a router, a transaction processing module and a terminal object;

d. a profiler module arranged to establish and control communication links between said network objects, said profiler being coupled to said database, accessing data in said database to control the establishment of communication links between the network

objects and routers;

e. said profiler being coupled to an input queue to receive input messages from said queue said messages comprising a source and destination heading and a message command to be interpreted by said profiler;

f. said profiler arranged to process the message and return a message to the source object or other objects;

g. said profiler arranged to process the message and return the processed result in the form of a message by writing the message to said queue of the router to which the profiler is coupled;

h. said router arranged to read input messages from a respective queue, check the message's destination and write the message to said respective queue of a respective router coupled to a preselected one of said network objects indicated on destination heading of the message;

i. said profiler arranged to process login and logout requests sent from network objects by matching the request message information against preselected access data in said database;

j. said profiler arranged to add objects to the network by processing said login requests and adding successfully logged objects to the database, and sending messages to other network objects of a new object login;

k. said transaction processing network objects arranged to send communication messages between themselves by combining the data with a message header, indicating the destination object and writing the message to a respective queue of a respective router connected to the source object.

28. The communication and notification system of claim 27, further comprising:

a. a plurality of PC interface modules in a mini computer environment coupled to said routers;

b. a plurality of PC router modules in a PC workstation environment, coupled to a PC interface module, arranged to invoke the PC interface module and transmit input from the PC workstation environment to the minicomputer environment; and

c. a preselected set of reference data

bases containing attribute information relating to data elements input to said first processor in connection with the plurality of transactions.

29. A store and forward module arranged to transmit data between computer hardware environments, the store and forward module comprising:

a. a first computer hardware environment having a first environment file format structure and at least one transaction processing module operating to create records;

b. a second computer hardware environment having a second environment file format structure;

c. a store and forward log, resident in the first computer hardware environment, containing individually numbered records on executed transactions, each record containing a code indicating a record number and at least one transaction processing source module in said first hardware environment that is the source of the records;

d. a first environment transmission module, resident in the first computer hardware environment, being coupled to said store and

forward log, accessing said store and forward log records and initiating transmission of the records to the second computer hardware environment;

e. a store and forward module resident in the second computer hardware environment, coupled to said first environment processing module, said store and forward module receiving the store and forward log records transmitted by said first environment transmission module;

f. a key file database coupled to said store and forward module, containing pre-selected translation and filing information relevant to records transmitted by said first environment transmission module and the transaction processor source module on said first hardware environment;

g. said store and forward module arranged to process said received records by the record number of each record transmitted by said first environment transaction module and translating each transmitted record from said first environment file format structure to said second environment file format structure, using key file translation information;

h. a plurality of second environment file format data storage files;

i. said store and forward processing module being coupled to said second environment file format data storage files, arranged to write the translated records to said second environment file format data storage files, using filing information in said key files;

j. a notification module, coupled to said store and forward processing module, arranged to generate sent messages containing the second environment file format data storage file locations of the new store and forward log updates.

30. A method of processing transaction data comprising:

a. a central database containing static transaction related information; and

b. transaction processing modules that processes transaction data by receiving transaction related data and processing that transaction data by accessing the static transaction related information in the central database to embellish the transaction data.

31. A method of transaction processing comprising:

a. a transaction information entry module including:

i. a transaction processing module having an input to receive information relevant to a plurality of individual transactions and for generation of individual transaction records, one corresponding to each one of the plurality of individual transactions, and

ii. a transaction record file coupled to said first processor for input and indexed storage of each one of the individual transaction records;

b. a database containing product attribute information;

c. a classification tree comprised of a plurality of linked nodes, the nodes containing information from said product attribute information database, the classification tree ordering the nodes according to a predetermined classification

scheme based on product attributes;

d. a traversal module arranged to read add, delete or modify nodes in the classification tree;

e. said transaction processing module processing said transaction input by invoking said traversal module to traverse said product classification tree and search the tree on a preselected search criteria; and

f. said transaction processing module arranged to accept the results of said product classification tree search and access said database based on entries corresponding to nodes in said product classification tree.

32. A method of processing transaction input comprising:

a. a database containing product information;

b. a classification tree comprised of a plurality of linked nodes, the nodes containing information from the product information, the classification tree ordering the nodes according to a predetermined classification scheme, the nodes coupled to

entries in the database;

c. a traversal module arranged to read add, delete or modify nodes in the classification tree; and

d. a data processing module coupled to the product classification tree and the traversal module and arranged to access the said database by invoking the traversal module to traverse the classification tree, read each node and then access the corresponding database entries.

33. The computer system of claim 6 wherein:

a. said transaction information entry module receives information relevant to a securities transaction including a purchase and sale of a financial security and related exchange of cash, on a trade date and information on a future settlement date for delivery of the financial security and exchange of the cash, and wherein:

b. said sub-modules include a cash management sub-module and a financial security clearance sub-module;

c. said cash management sub-module includes

an integrated payable and receivable file and performs transaction processing to record cash due and cash payable and related settlement date information from each one of the transaction records;

d. said security clearance module comprises:

i. a clearance main file,

ii. a first module arranged to access each transaction record from said transaction record file and to process each transaction record to create a record denoting the settlement date of the receipt or delivery of the financial security of the respective transaction record and write each created record to said clearance main file,

iii. a clearance line up file,

iv. a second module arranged to access the clearance main file, select created records indicating receipt or delivery of a financial security on a certain date and write the selected created records to said clearance line up file,

v. a second module arranged to receive

input concerning the settlement of executed transactions, settlement input comprising data relevant to whether the product of the executed trade was received or delivered,

vi. a clearance detail file,

vii. said second module arranged to process the input concerning the settlement of executed transactions, processing comprised of updating the record in said clearance main file with the data input, storing each data input in said clearance detail file.

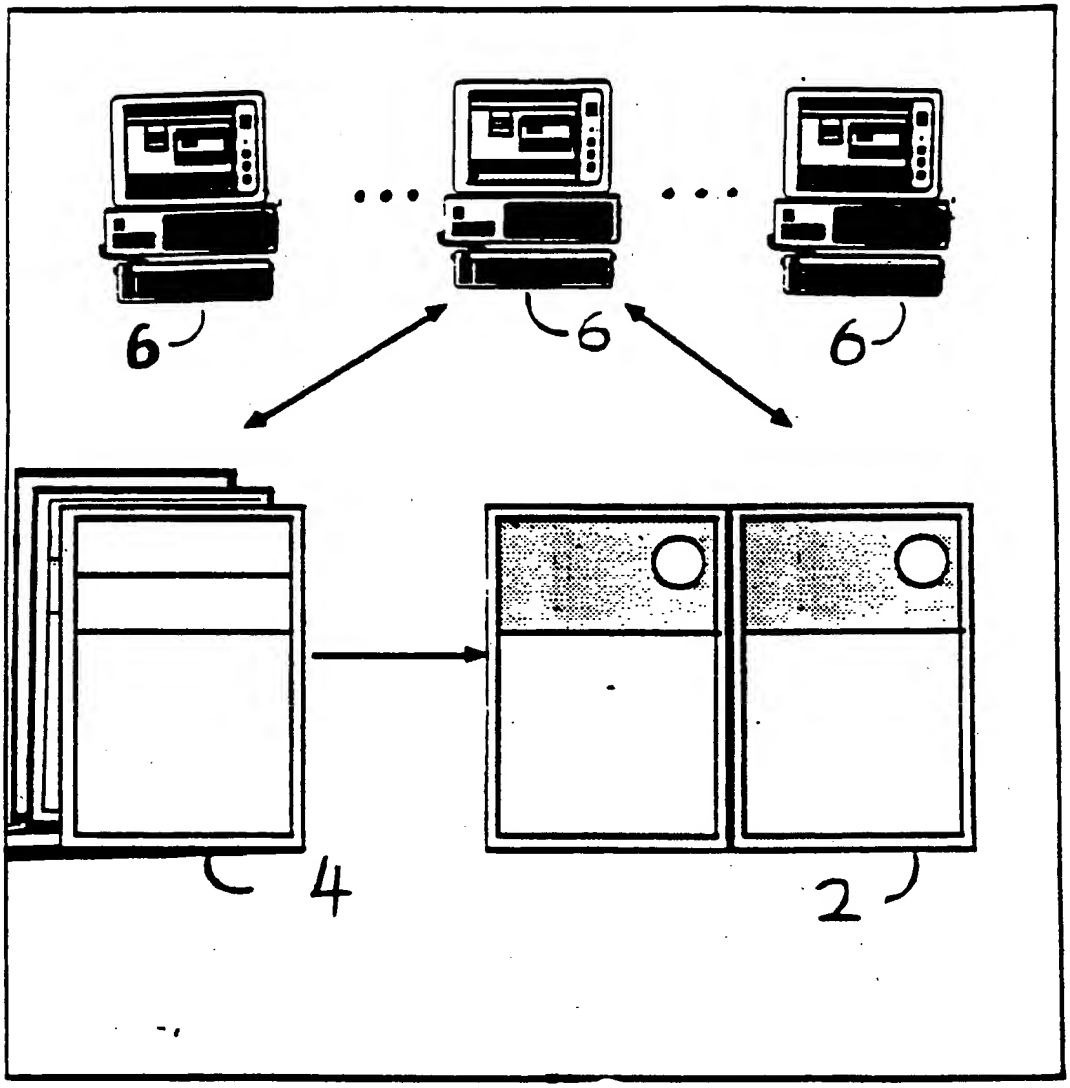
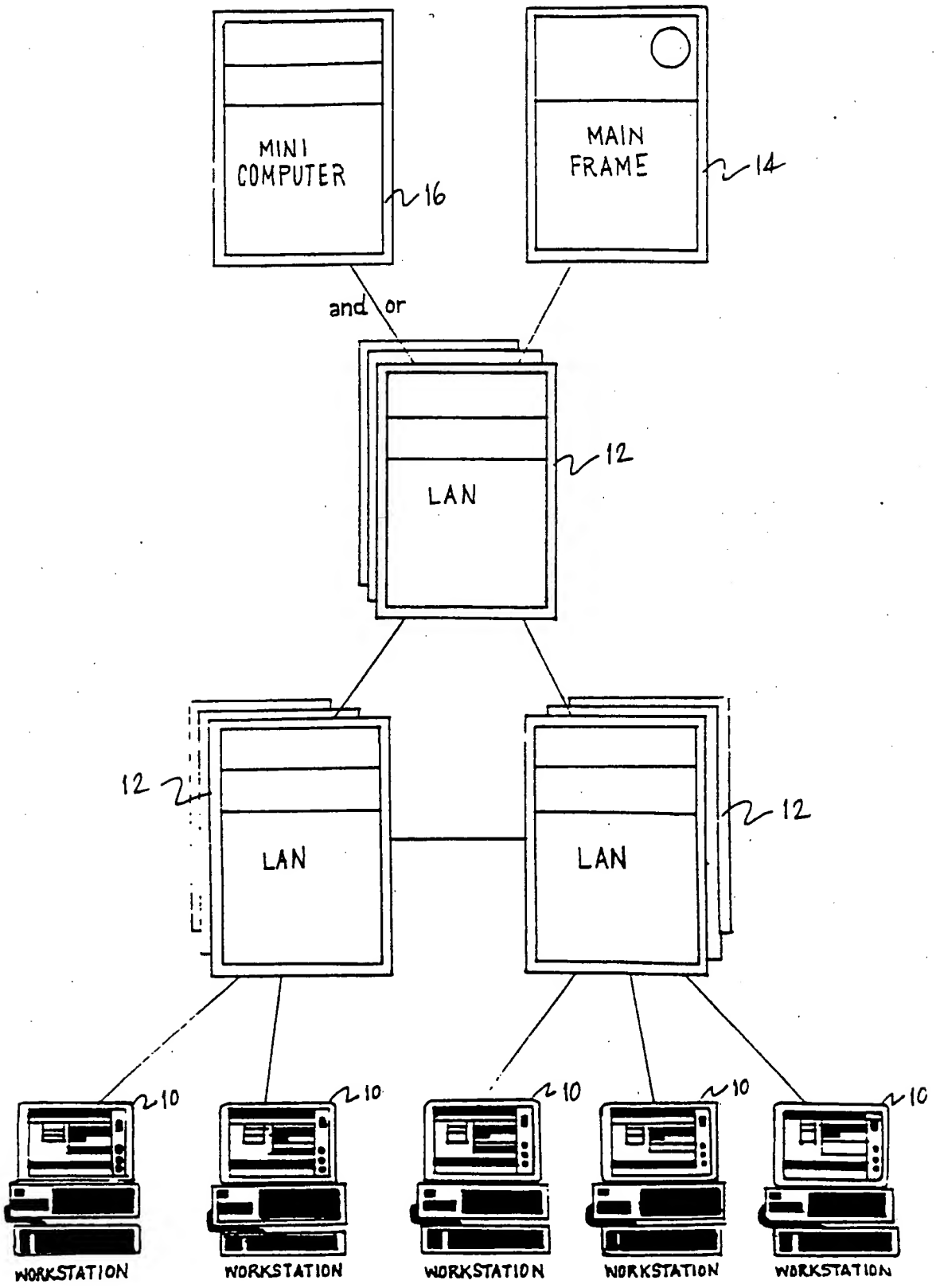


Fig 1


MINI COMPUTER
16
MAIN FRAME
14
and or
LAN
12
12
LAN
LAN
12
10
10
10
10
10
WORKSTATION
WORKSTATION
WORKSTATION
WORKSTATION
WORKSTATION

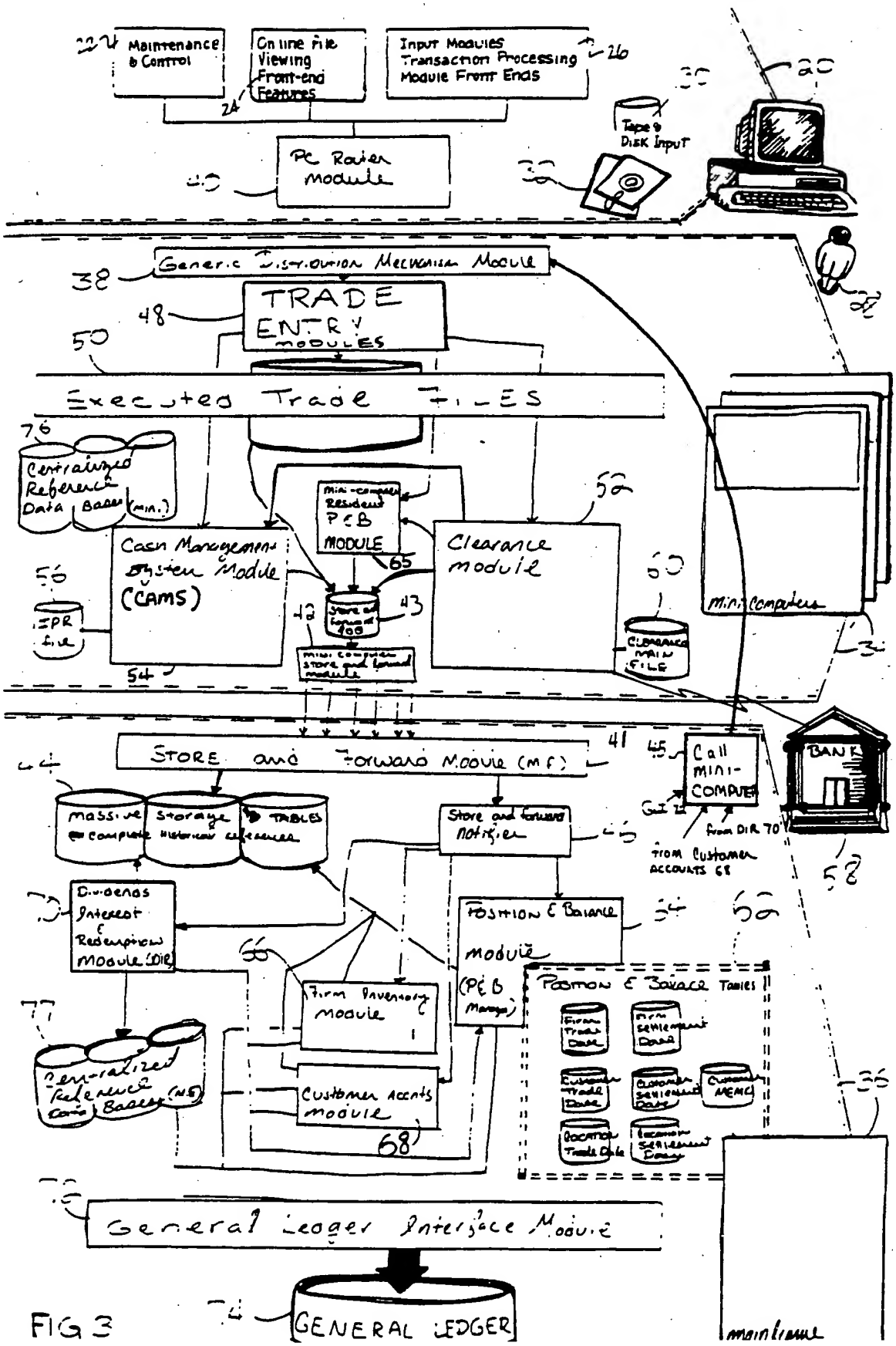

Maintenance & Control
On line file Viewing Front-end Features
Input Modules Transaction Processing Module Front Ends
PC Router Module
Tape & Disk Input
Generic Distribution Mechanism Module
TRADE ENTRY MODULES
Executed Trade FILES
Centralized Reference Data Base (min.)
Mini-computer Resident P&B MODULE
Cash Management System Module (CAMS)
Clearance module
EPR file
Clearance main file
mini computers
STORE and FORWARD Module (MF)
Call MINI-COMPUTER
BANK
from DIR 70
from Customer ACCOUNTS 68
Store and forward notifier
Massive storage TABLES
Dividends Interest & Redemptions Module (DIR)
POSITION & BALANCE module (P&B Manager)
Firm Inventory module
Customer Accounts module
Generalized Reference Data Base (NS)
POSITION & BALANCE TABLES
General Ledger Interface Module
GENERAL LEDGER
mainframe

FIG 3

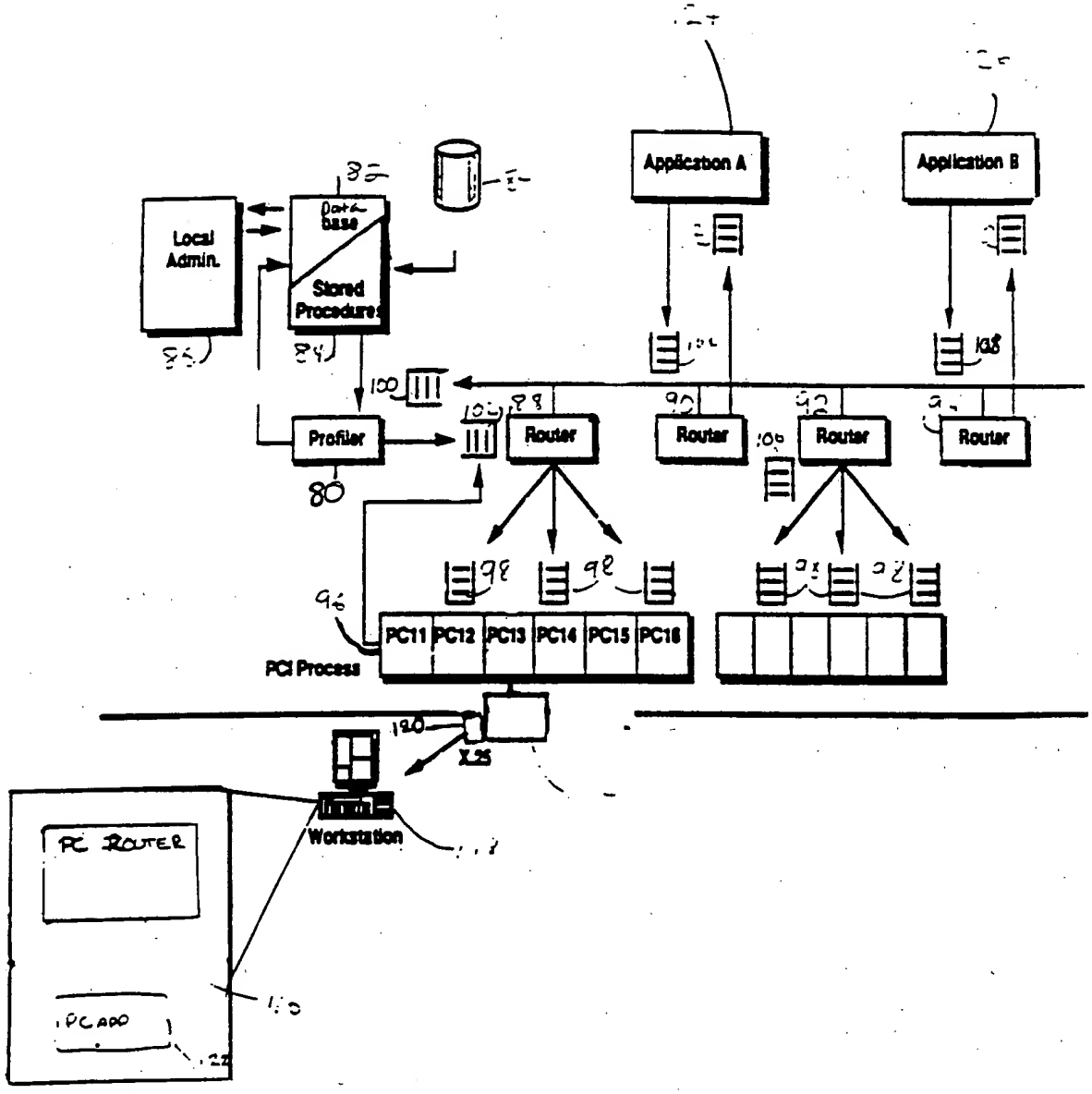

Application A
Application B
Local Admin.
Data base
Stored Procedures
Profiler
Router
Router
Router
Router
PC11
PC12
PC13
PC14
PC15
PC16
PCI Process
X.25
Workstation
PC ROUTER
IPCAPD

Fig. 4

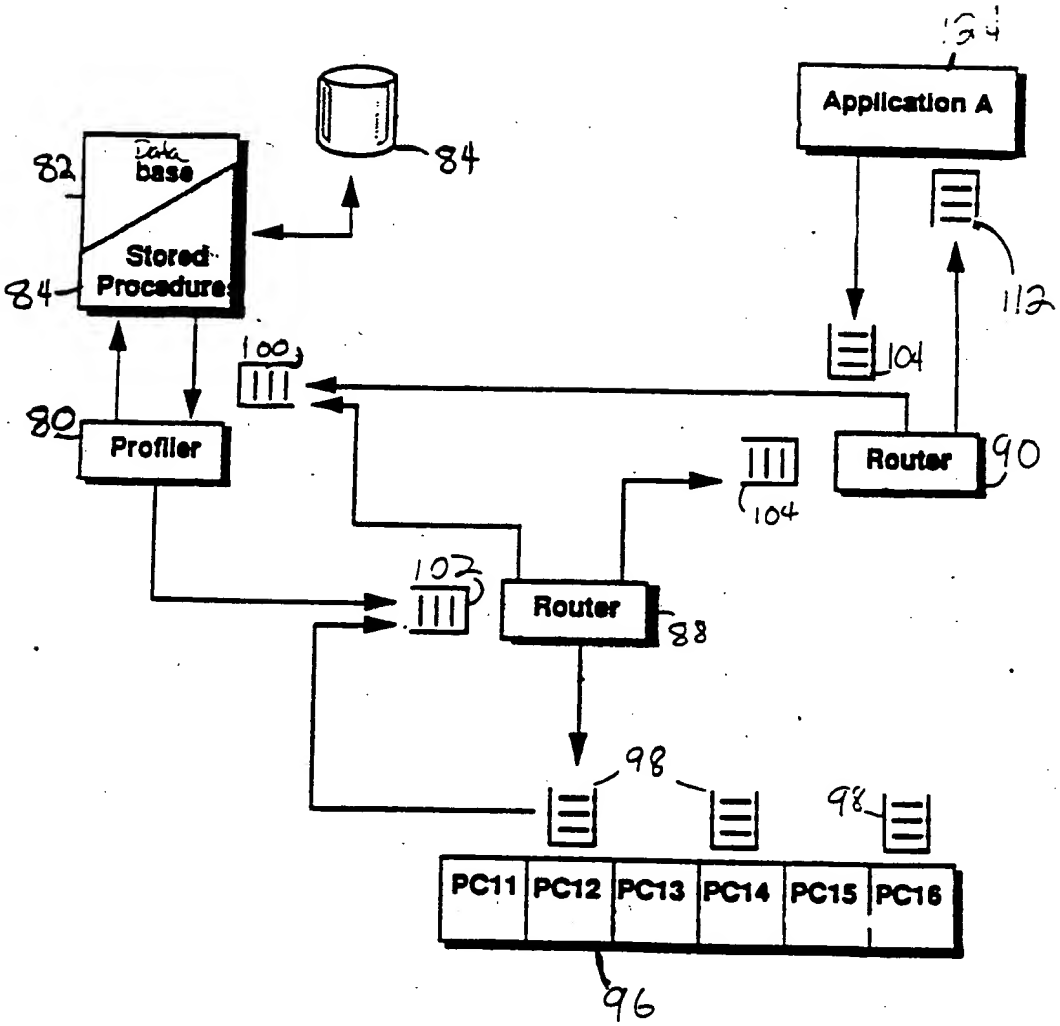

Application A
84
82
Data base
Stored Procedures
84
112
104
100
80
Profiler
Router
90
104
102
Router
88
98
98
PC11
PC12
PC13
PC14
PC15
PC16
96

FIG 4a

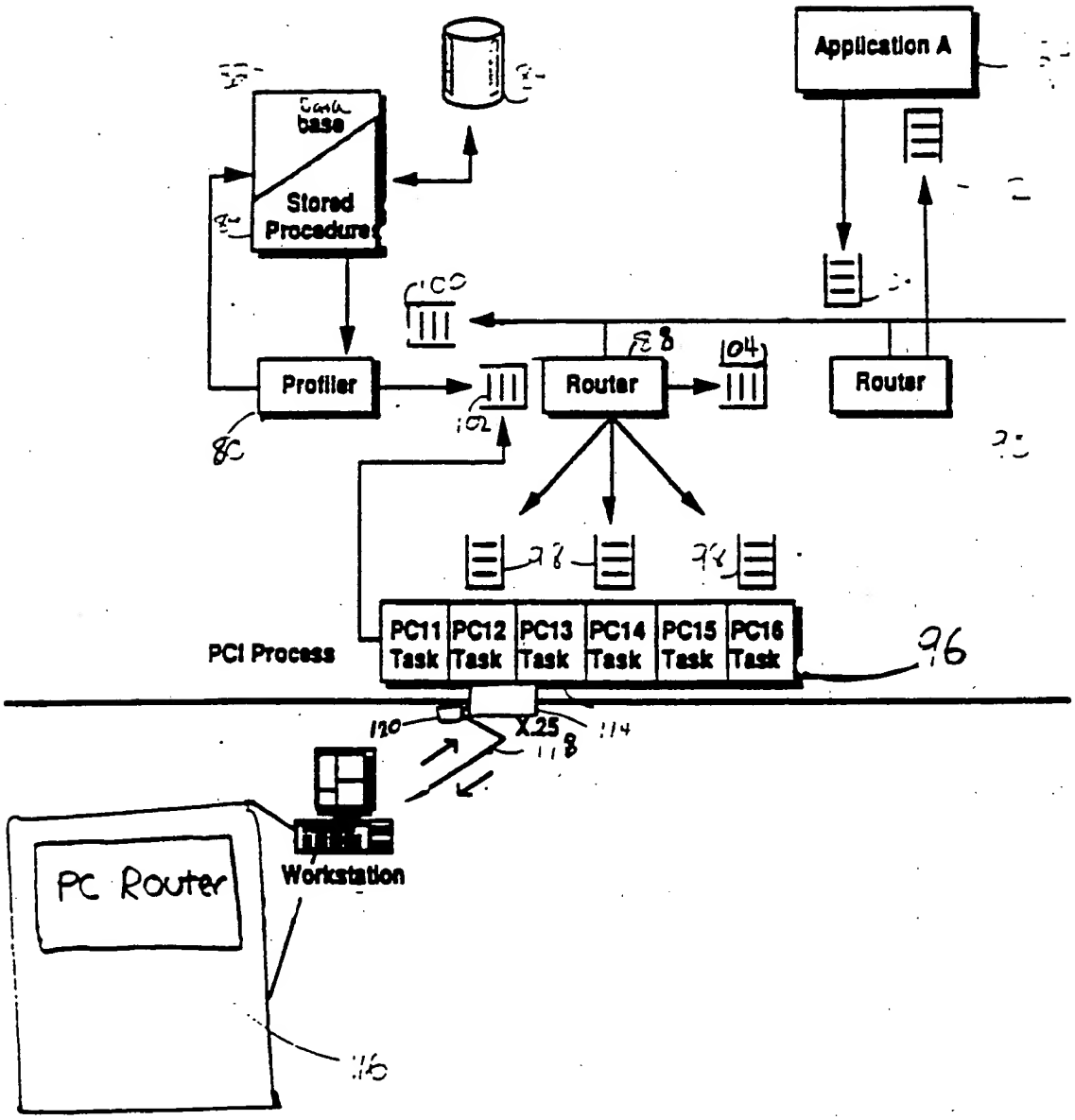
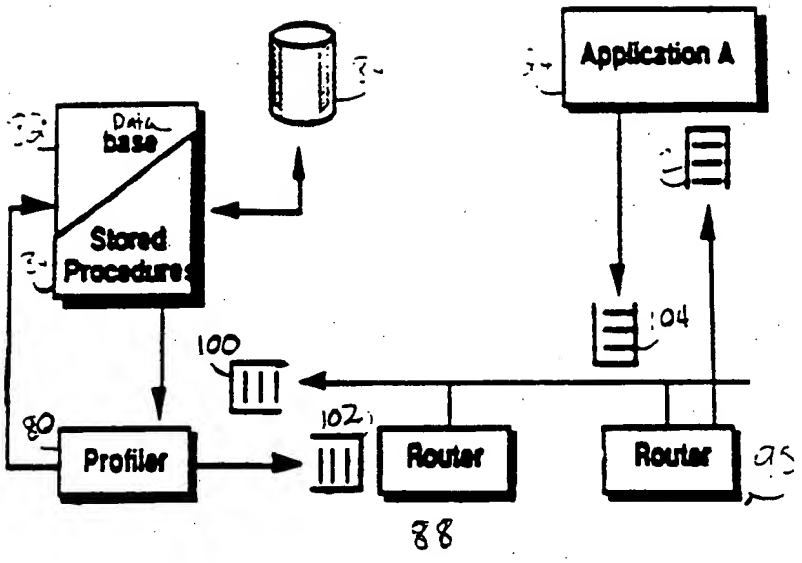

Application A
Data base
Stored Procedure
Profiler
Router
Router
PCI Process
PC11 Task
PC12 Task
PC13 Task
PC14 Task
PC15 Task
PC16 Task
96
X.25
Workstation
PC Router

FIG 4b


Application A
Data base
Stored Procedures
Profiler
Router
Router
100
102
104
80
88

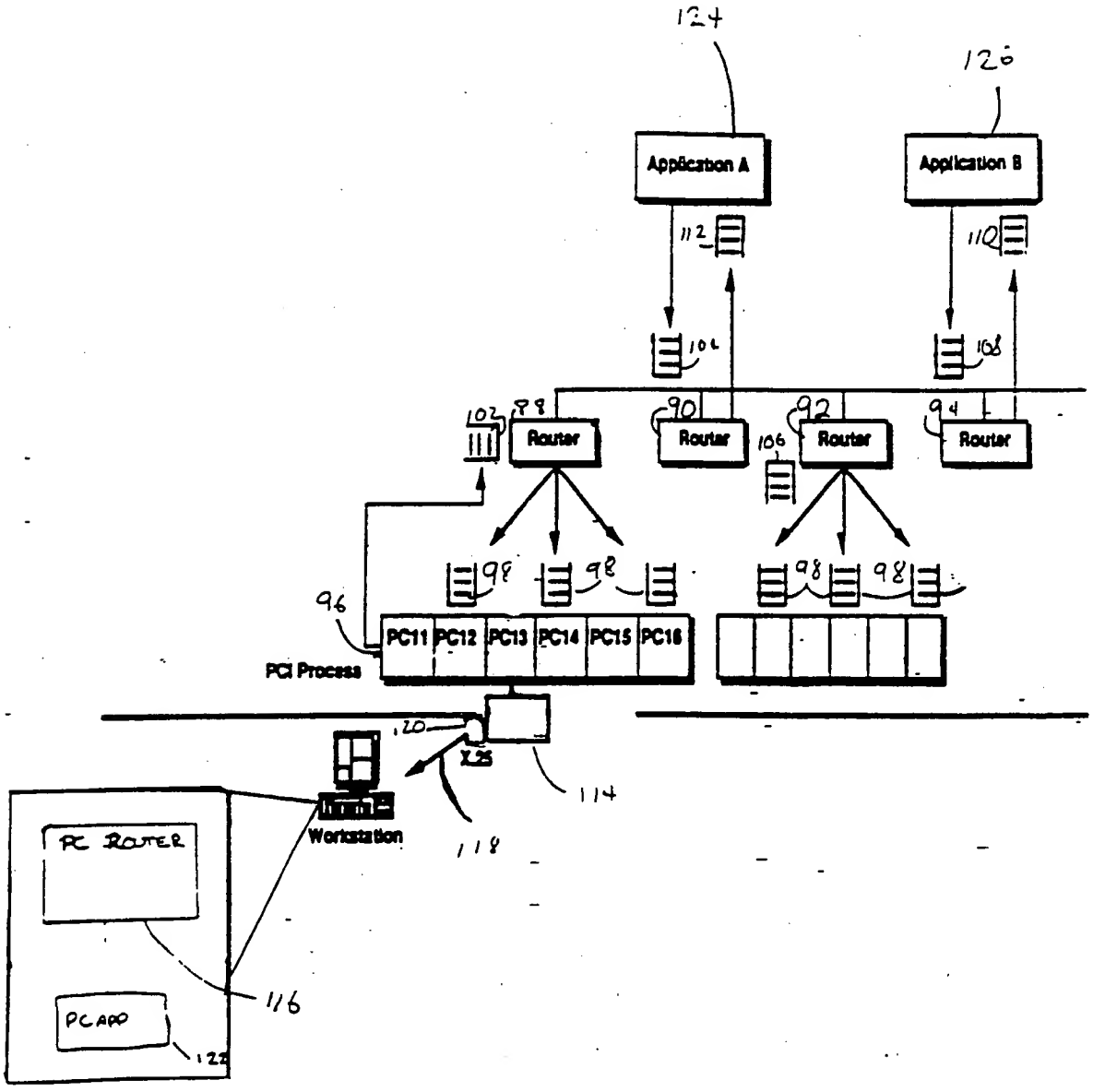

124
126
Application A
Application B
112
110
104
108
102
88
90
92
94
Router
Router
Router
Router
106
98
98
98
98
96
PC11
PC12
PC13
PC14
PC15
PC16
PCI Process
120
X.25
114
Workstation
118
PC ROUTER
116
PC APP
122

Fig. 4 d

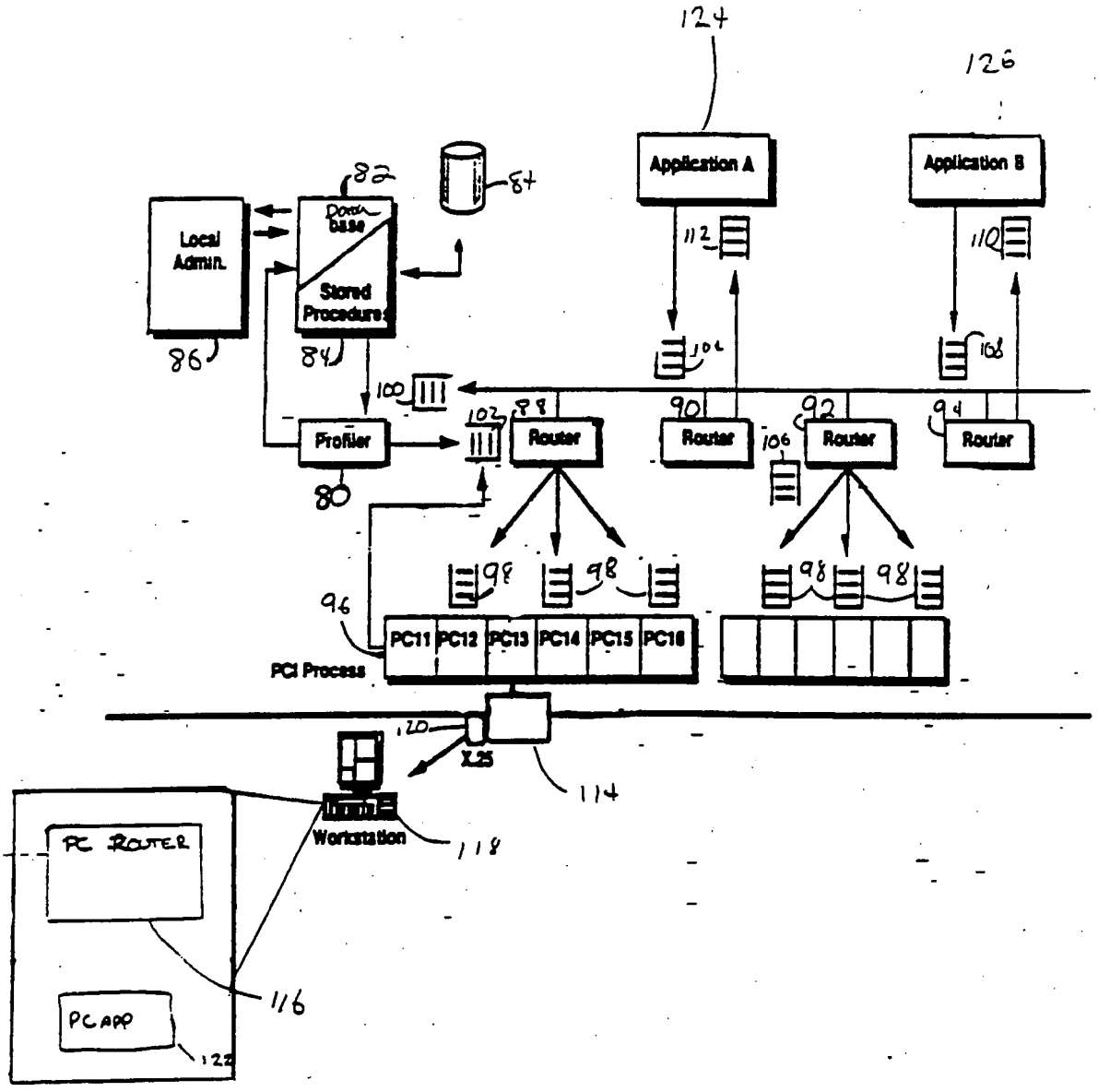

124
126
Application A
Application B
82
84
Data base
Stored Procedures
Local Admin.
86
Profiler
80
Router
Router
Router
Router
PC11
PC12
PC13
PC14
PC15
PC16
PCI Process
X.25
Workstation
PC ROUTER
PC APP
116
118
114

Fig. 4e

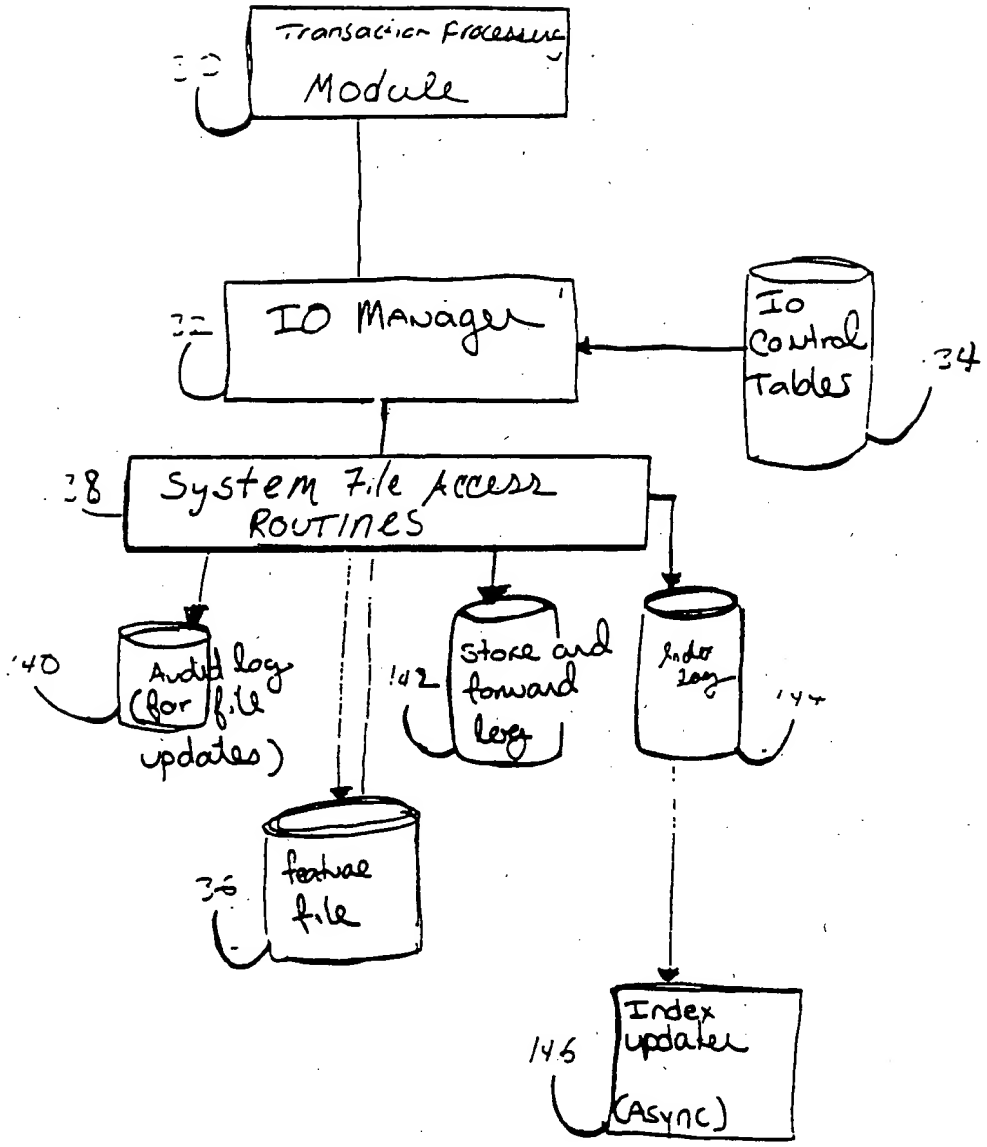
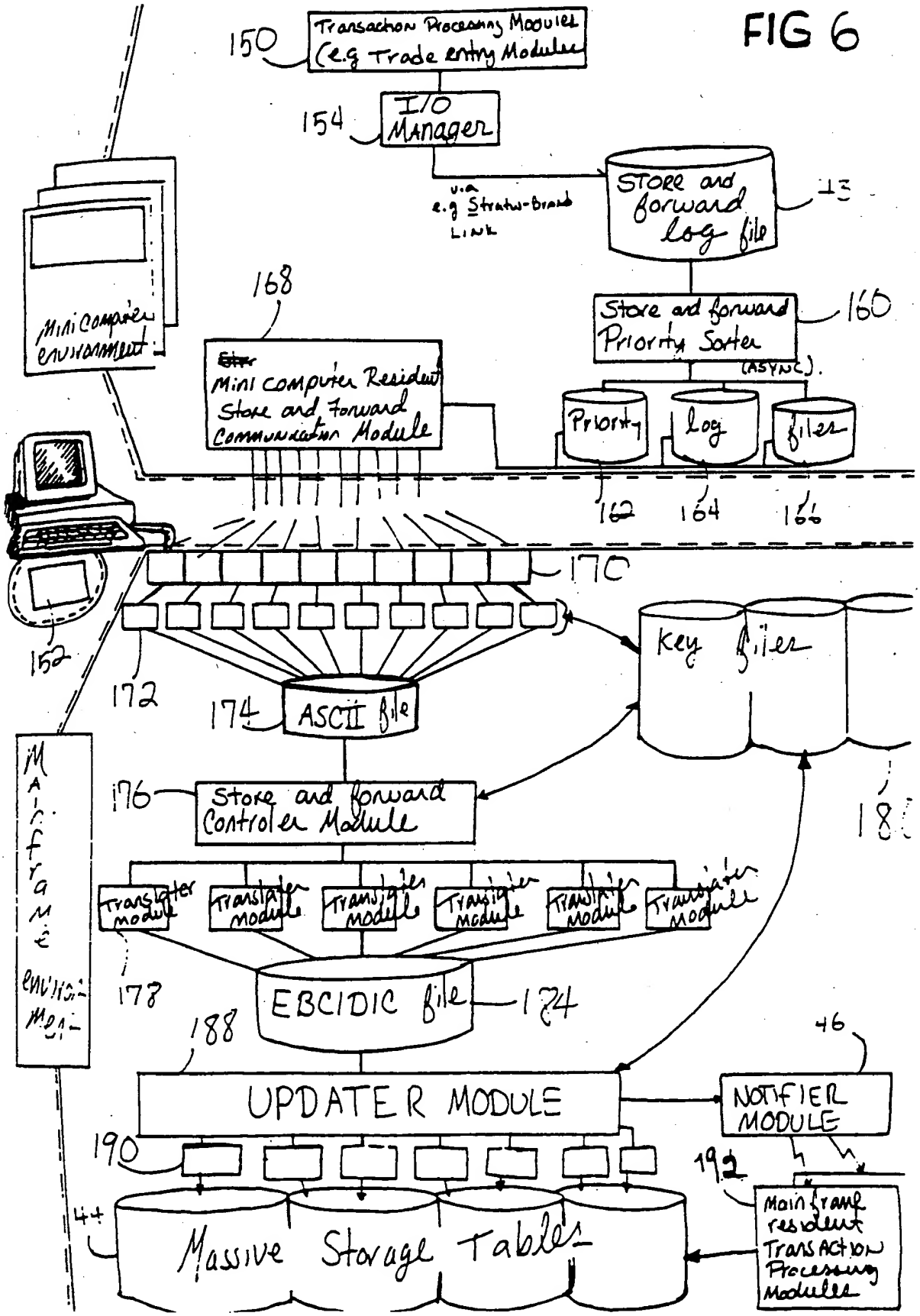


FIG 5
(IO MANAGER)

FIG 6


150
Transaction Processing Module (e.g. Trade entry Module)
154
I/O Manager
via e.g. Stratus-brand LINK
Store and forward log file
13
168
Mini computer environment
Mini computer Resident Store and Forward Communication Module
Store and forward Priority Sorter
160
(ASYNC).
Priority
Log
filer
162
164
166
170
152
172
174
ASCII file
Key filer
Mainframe environment
176
Store and forward Controller Module
Translator module
178
EBCIDIC file
188
UPDATER MODULE
46
NOTIFIER MODULE
190
192
Mainframe resident Transaction Processing Modules
44
Massive Storage Tables

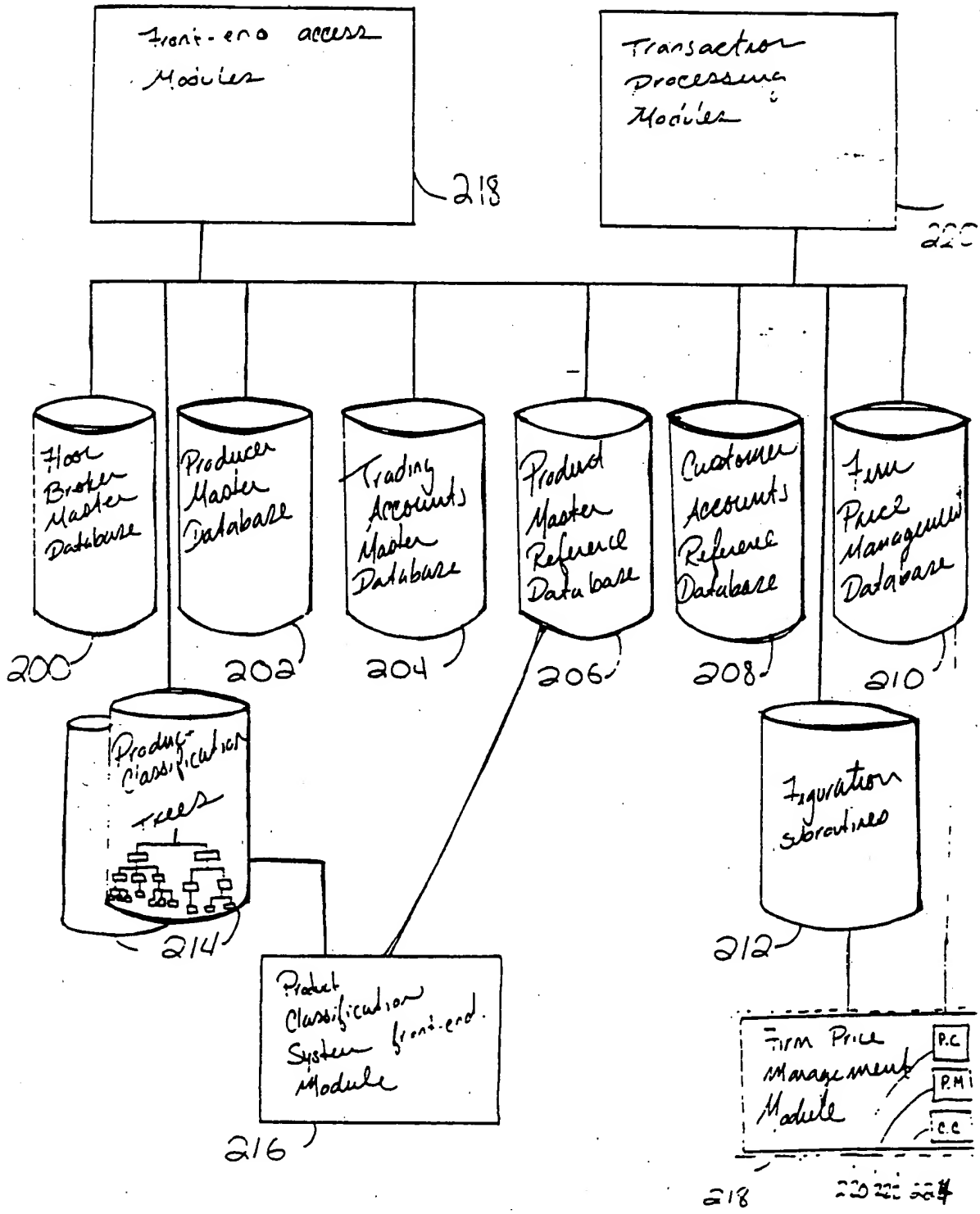

Front-end access Modules
218
Transaction Processing Modules
220
Floor Broker Master Database
200
Producer Master Database
202
Trading Accounts Master Database
204
Product Master Reference Database
206
Customer Accounts Reference Database
208
Firm Price Management Database
210
Product Classification Trees
214
Product Classification System front-end Module
216
Figuration Database
212
Firm Price Management Module
P.C
P.M
C.C
218
220
222
224

FIG 7

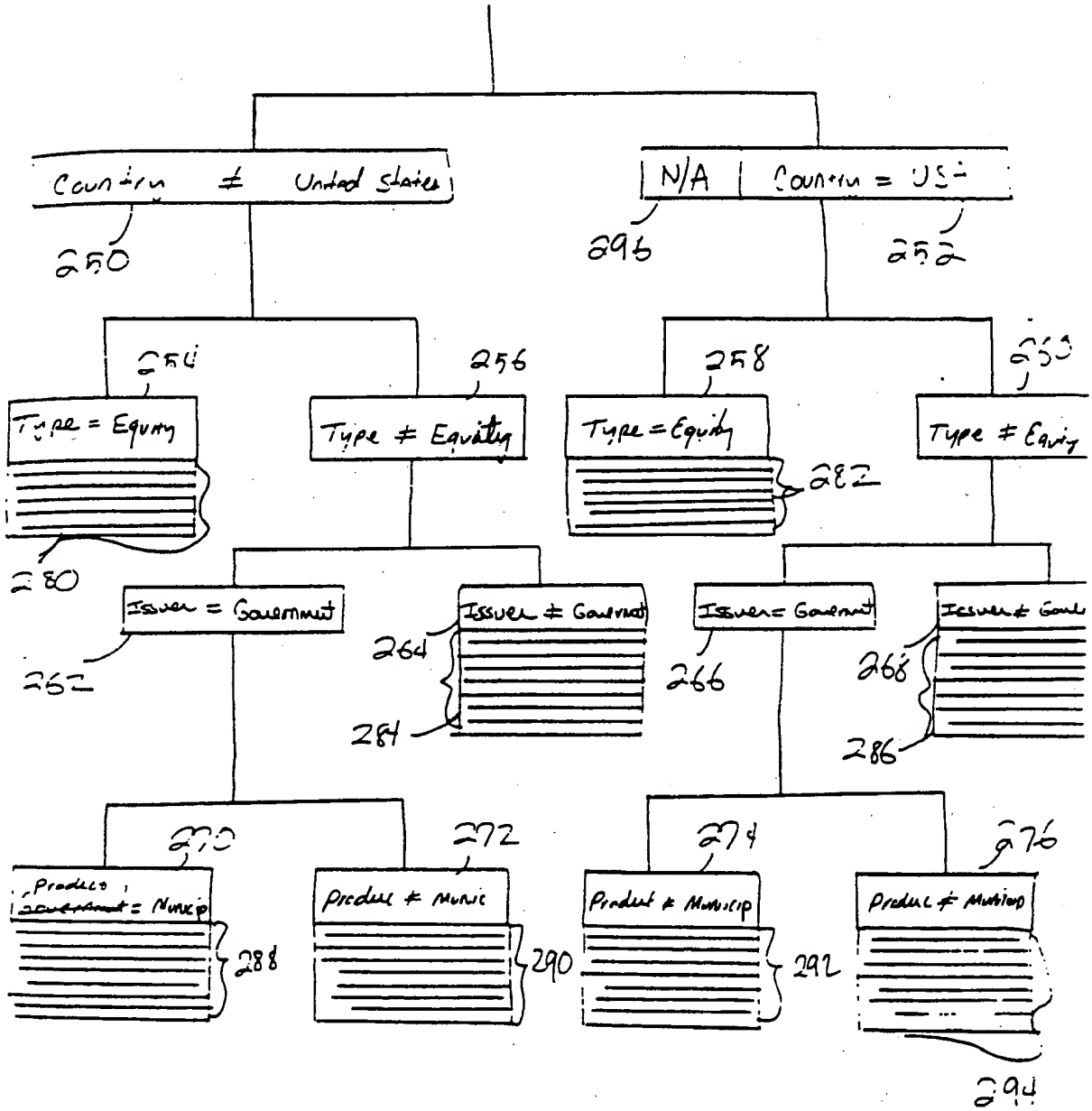

Country ≠ United States
250
N/A | Country = US
296
252
254
256
258
260
Type = Equity
Type ≠ Equity
Type = Equity
Type ≠ Equity
280
282
Issuer = Government
Issuer ≠ Government
Issuer = Government
Issuer ≠ Gov
262
264
266
268
284
286
270
272
274
276
Product = Municip
Product ≠ Munic
Product ≠ Municip
Product ≠ Municip
288
290
292
294

FIG 8.

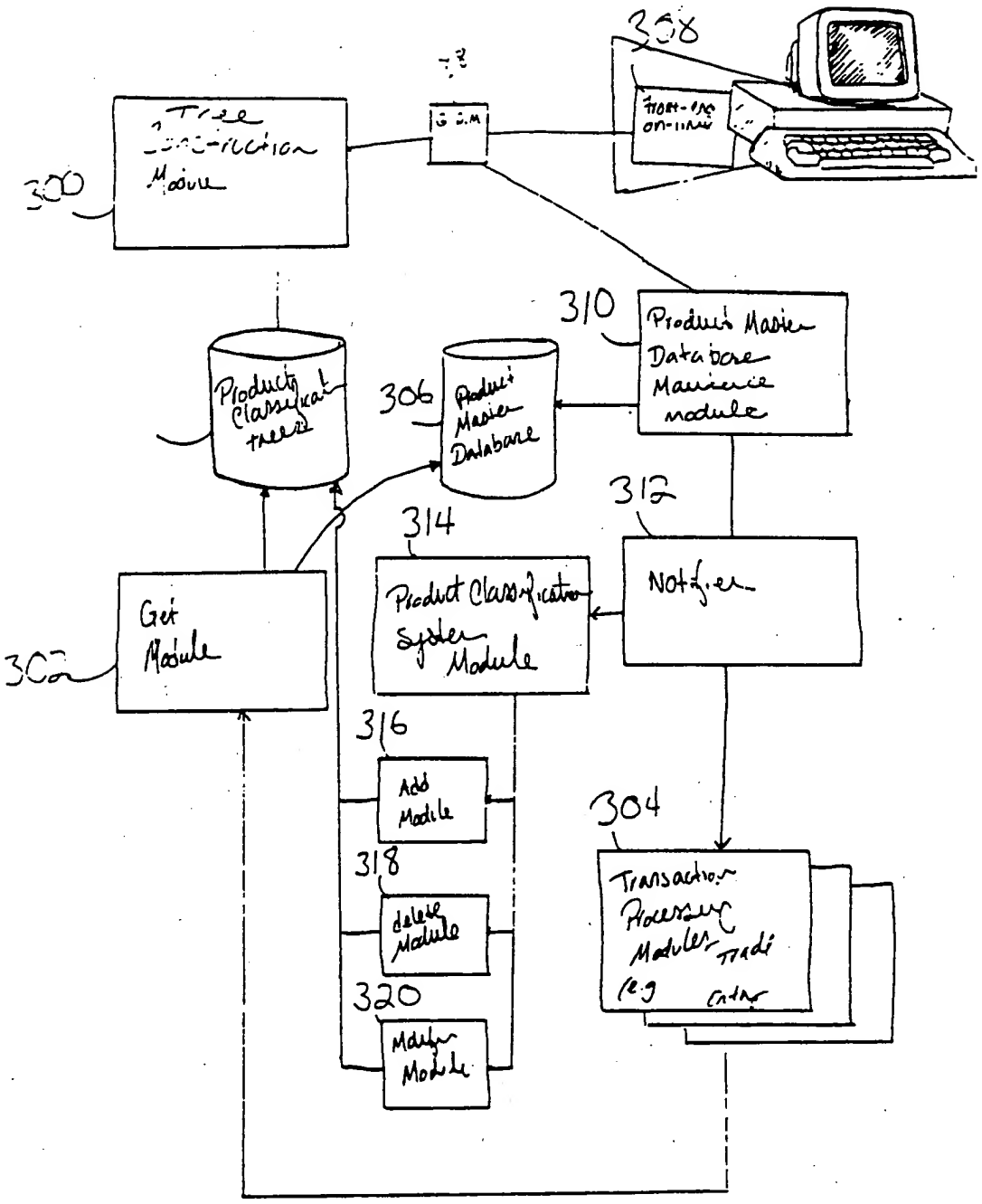

308
Front-end on-line
300
Tree construction Module
GUI
310
Product Master Database Maintenance module
Product Classification trees
306
Product Master Database
312
314
Notifier
Product Classification System Module
Get Module
302
316
Add Module
304
318
delete Module
Transaction Processing Modules
320
Modify Module

FIG 9

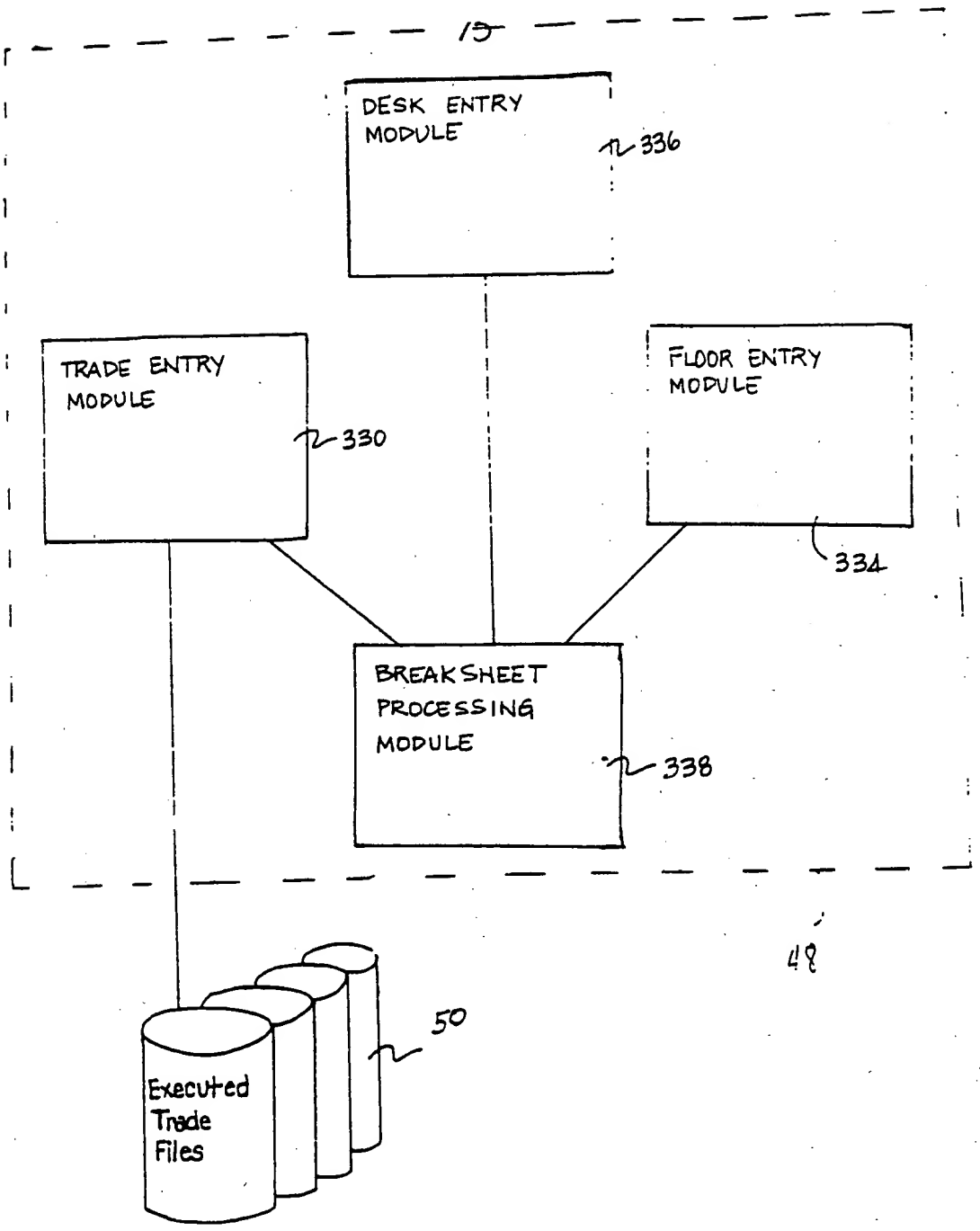

DESK ENTRY MODULE
336
TRADE ENTRY MODULE
330
FLOOR ENTRY MODULE
334
BREAKSHEET PROCESSING MODULE
338
48
50
Executed Trade Files

Fig 10

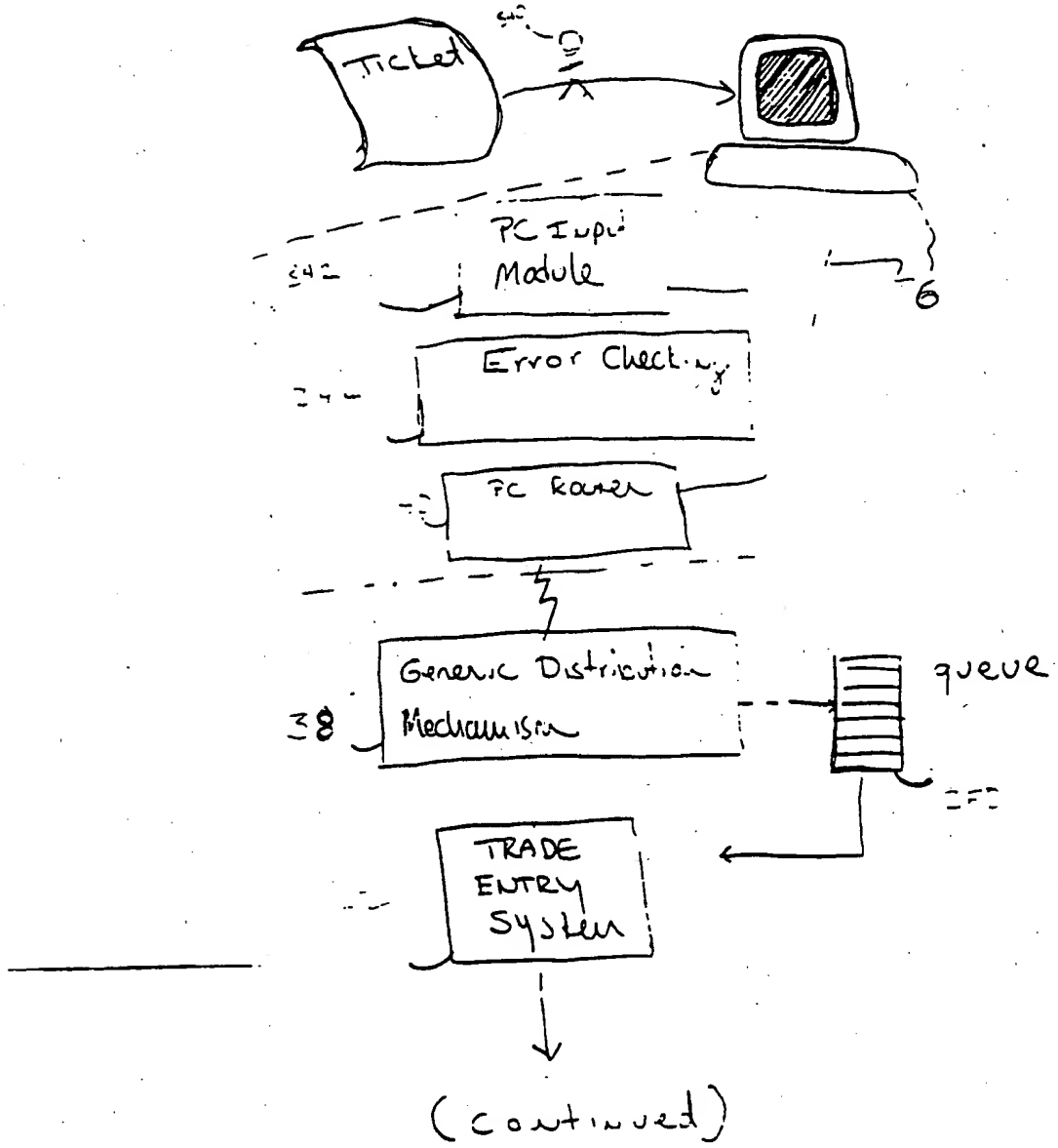
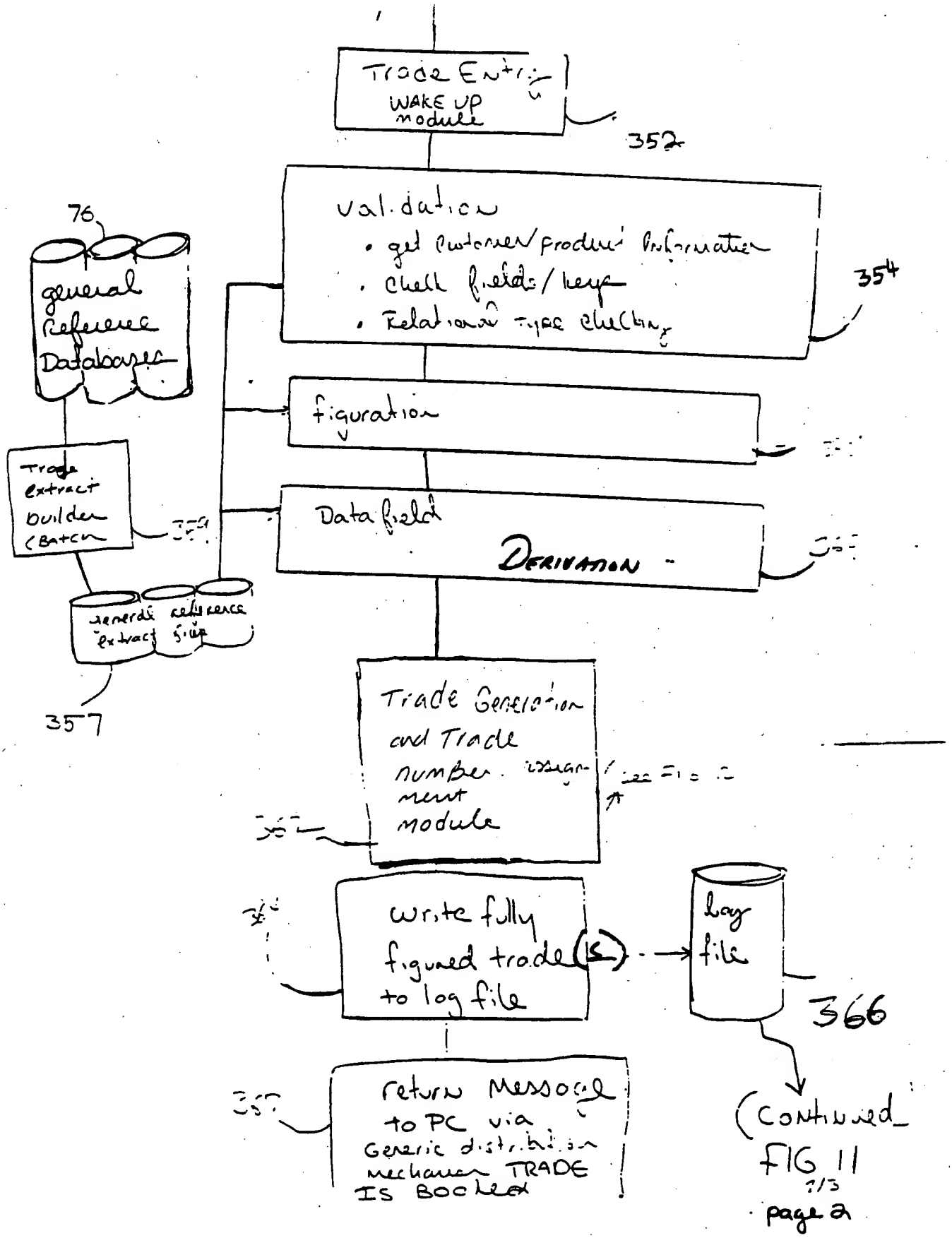


FIG 11
13
page 1


Trade Entry
WAKE UP
module
352
Validation
• get customer/product information
• Check fields/keys
• Relationship type checking
354
76
general
Reference
Databases
figuration
Trade
extract
builder
(Batch
Data field
DERIVATION
generate reference
extract files
357
Trade Generation
and Trade
number assign-
ment
module
write fully
figured trade(s)
to log file
log
file
366
return Message
to PC via
Generic distribution
mechanism TRADE
IS BOOKED
(CONTINUED
FIG 11
2/3
page 2

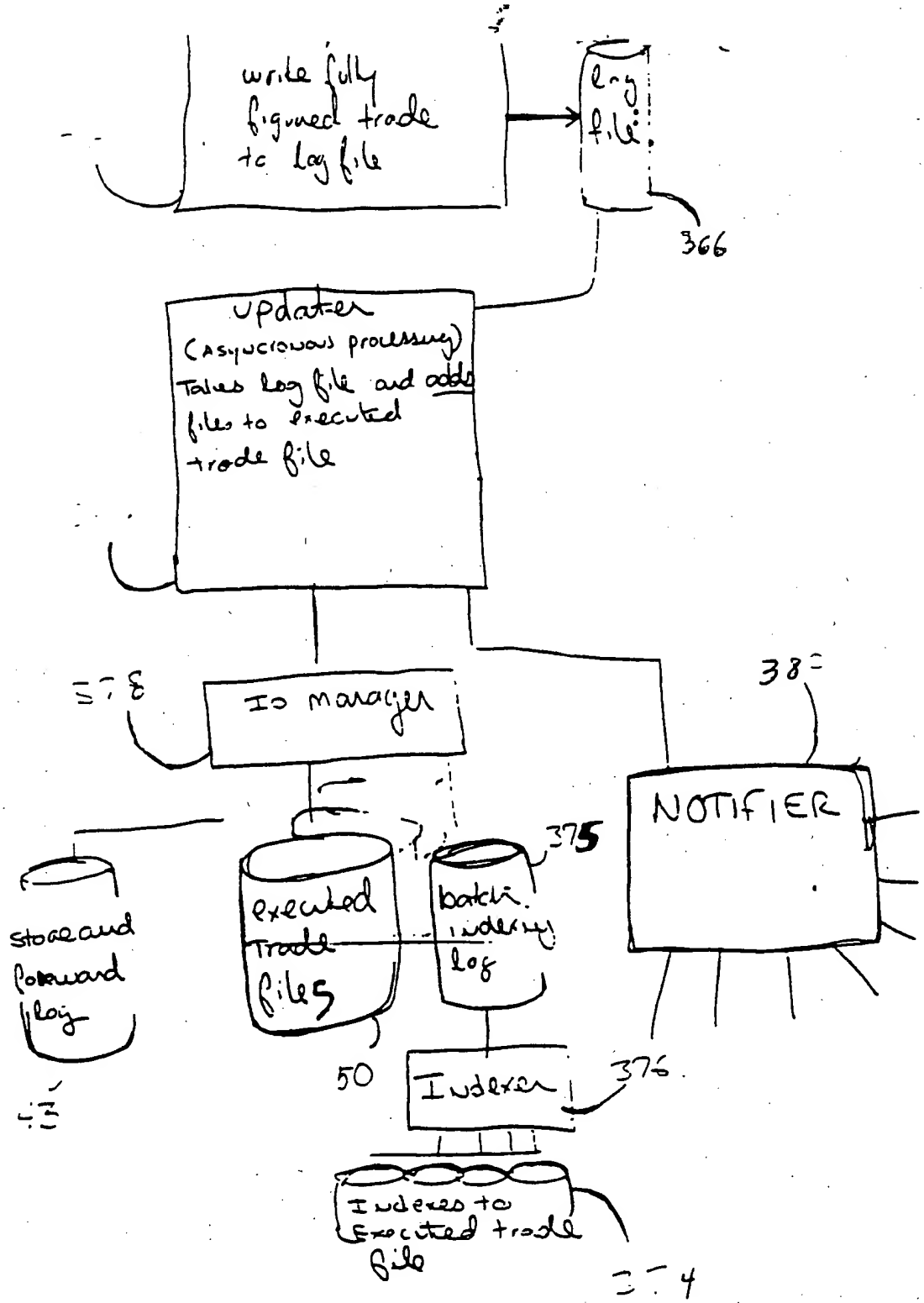


FIG 11
3/3
page 3

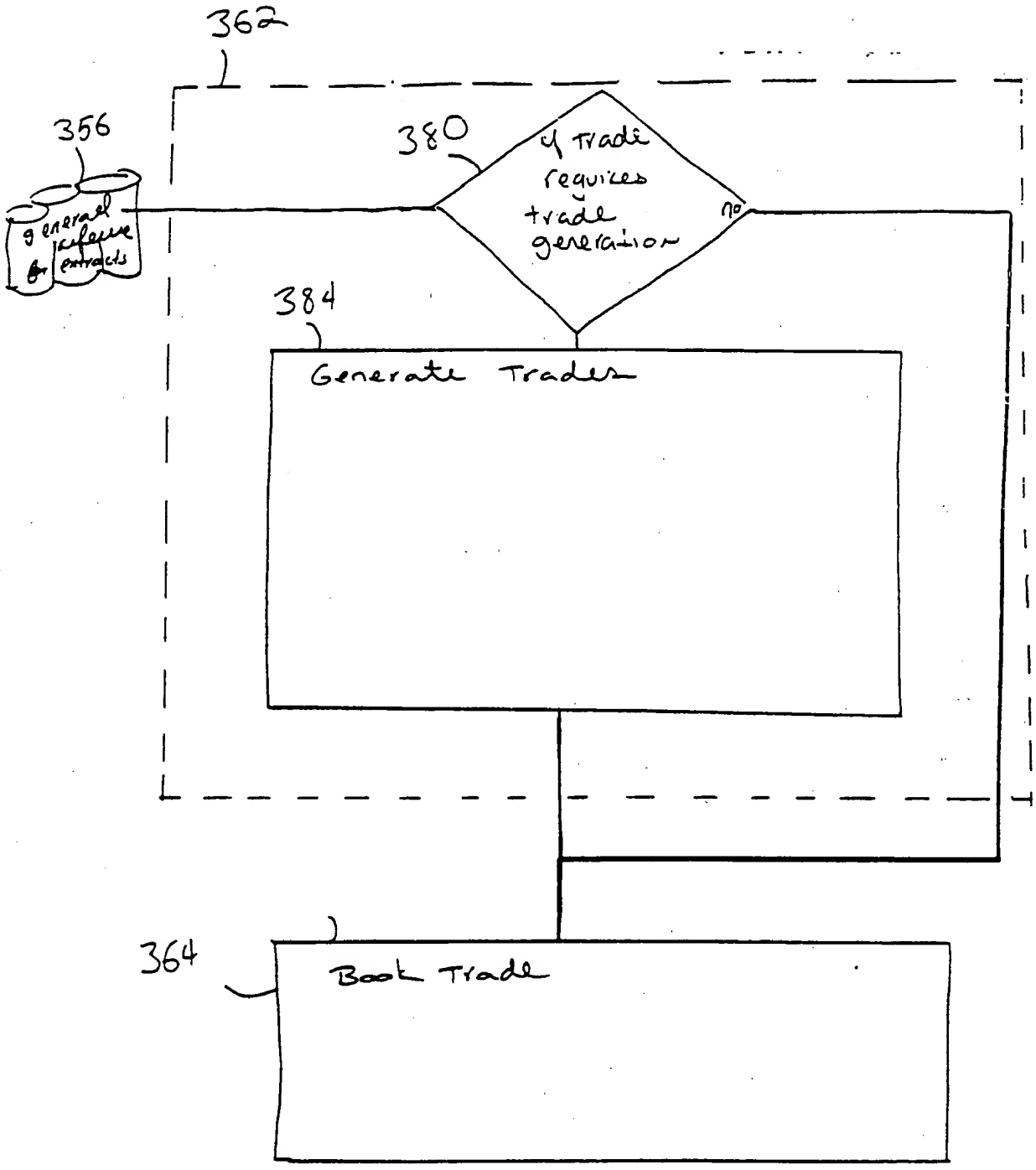

362
356
380
if trade requires trade generation
no
general reference contracts
384
Generate Trades
364
Book Trade

FIG 11a

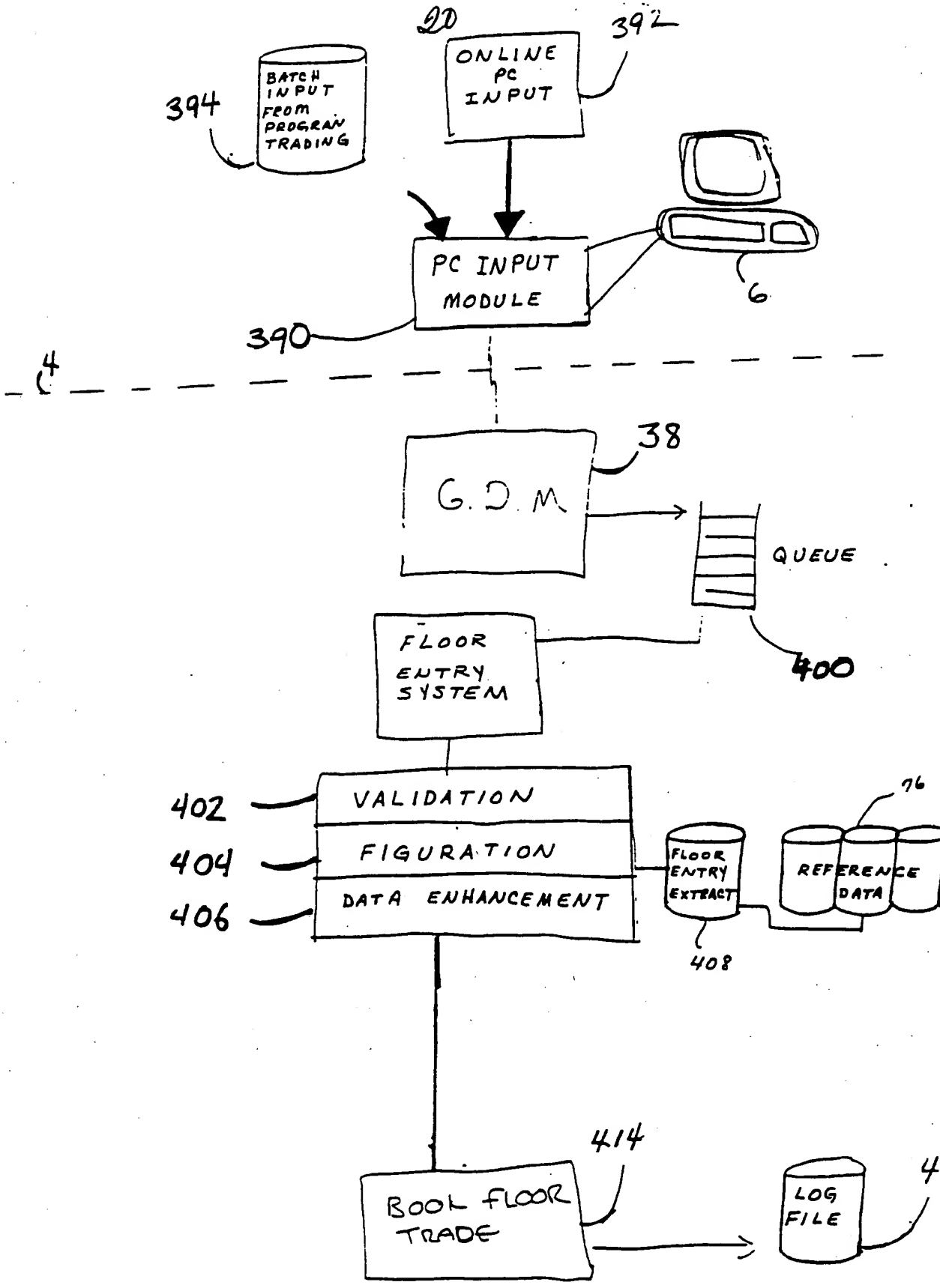

20
392
ONLINE PC INPUT
394
BATCH INPUT FROM PROGRAM TRADING
PC INPUT MODULE
6
390
4
38
G.D.M.
QUEUE
400
FLOOR ENTRY SYSTEM
402
VALIDATION
404
FIGURATION
406
DATA ENHANCEMENT
76
FLOOR ENTRY EXTRACT
REFERENCE DATA
408
414
BOOK FLOOR TRADE
412
LOG FILE

FIG 1
page 1

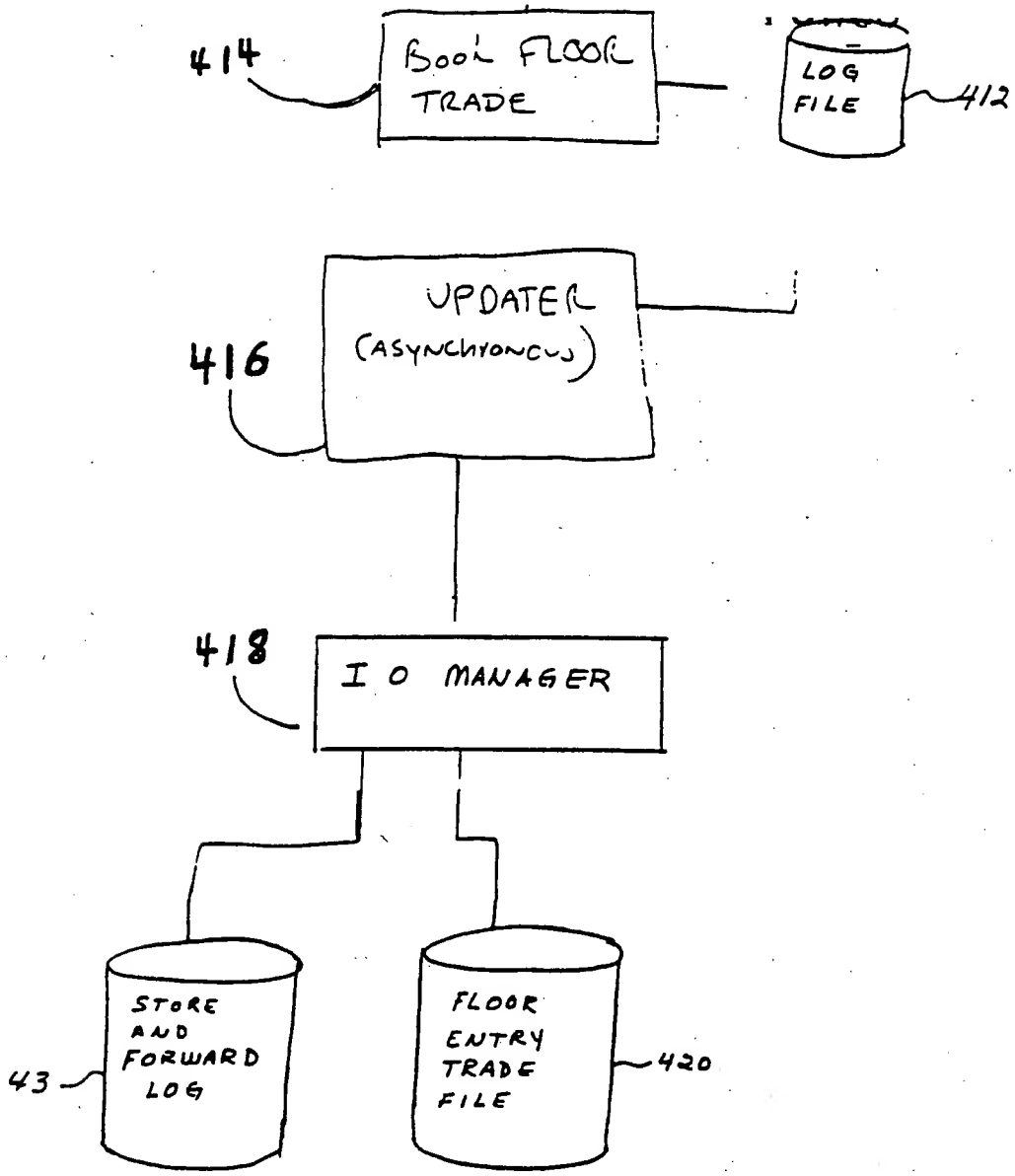
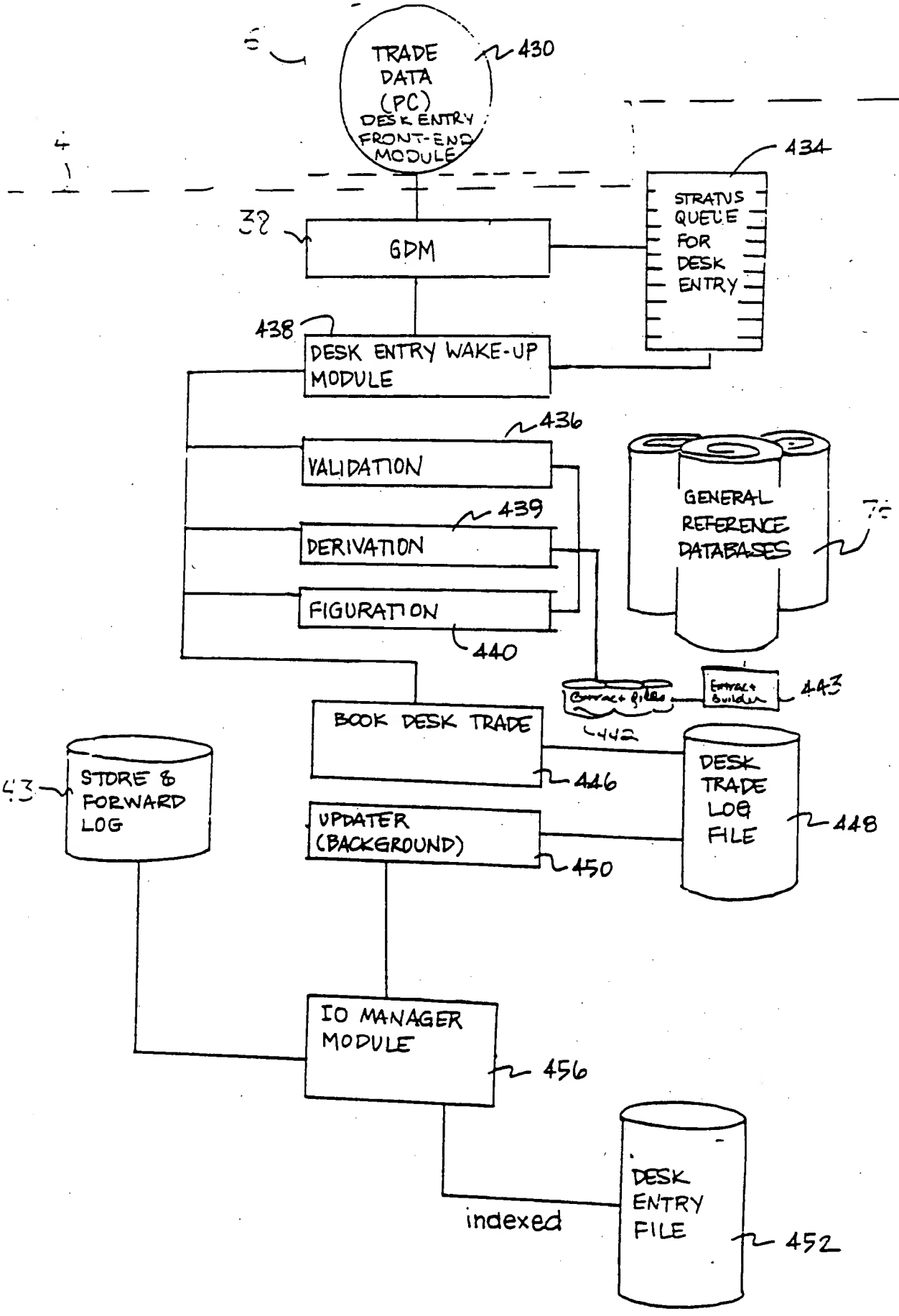
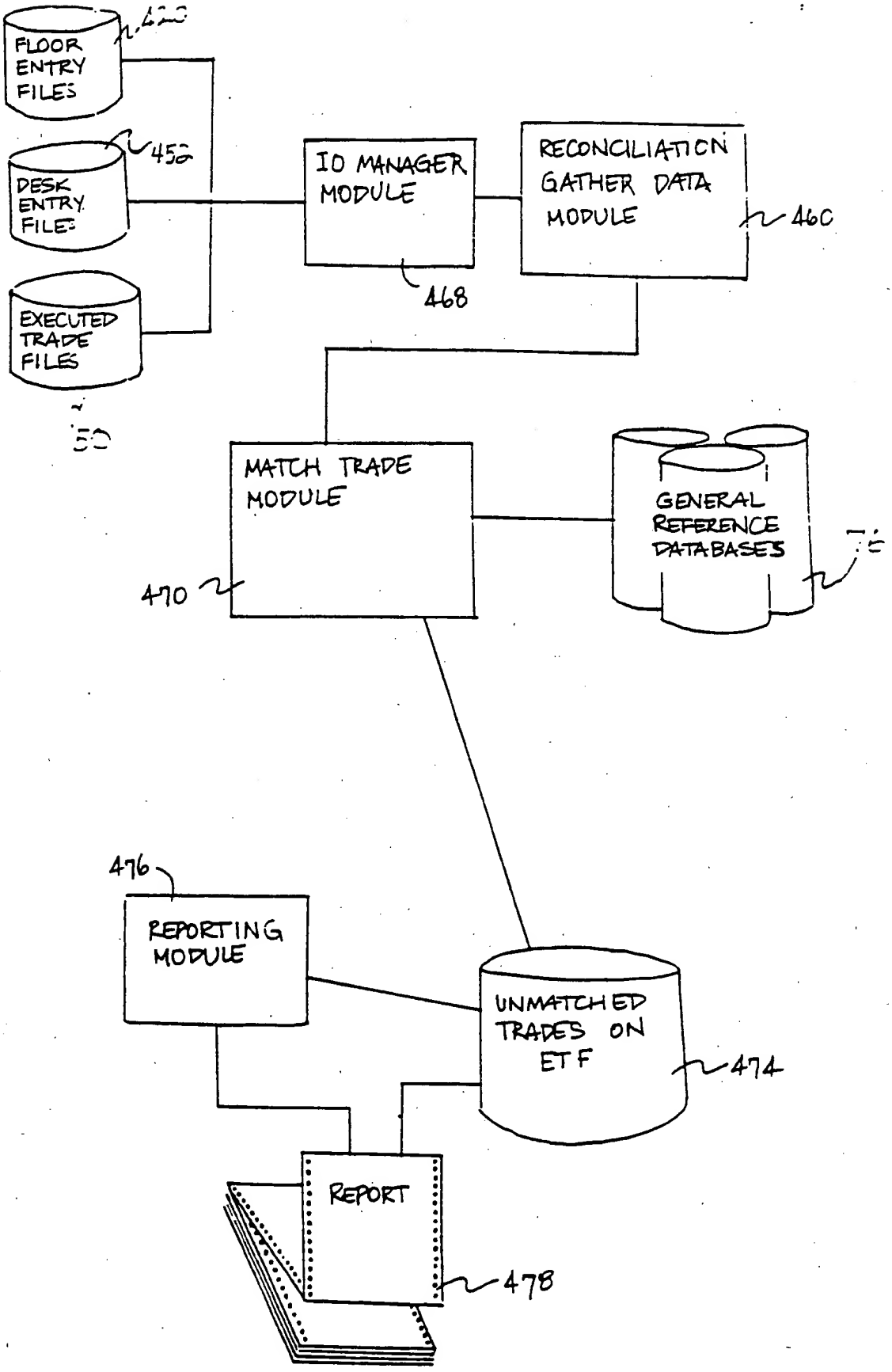
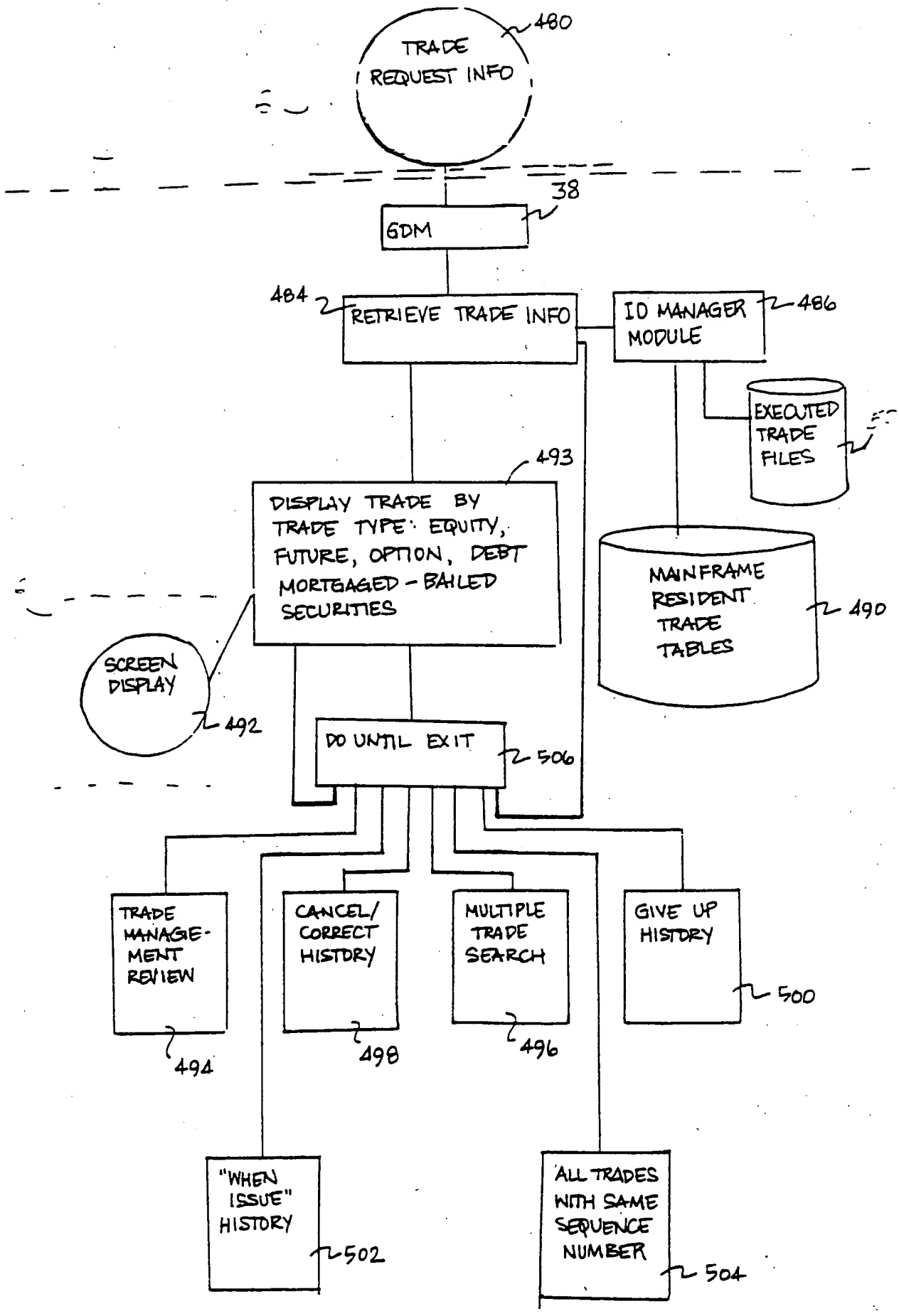

414
BOOK FLOOR TRADE
LOG FILE
412
UPDATER (ASYNCHYONCUS)
416
418
I O MANAGER
STORE AND FORWARD LOG
43
FLOOR ENTRY TRADE FILE
420

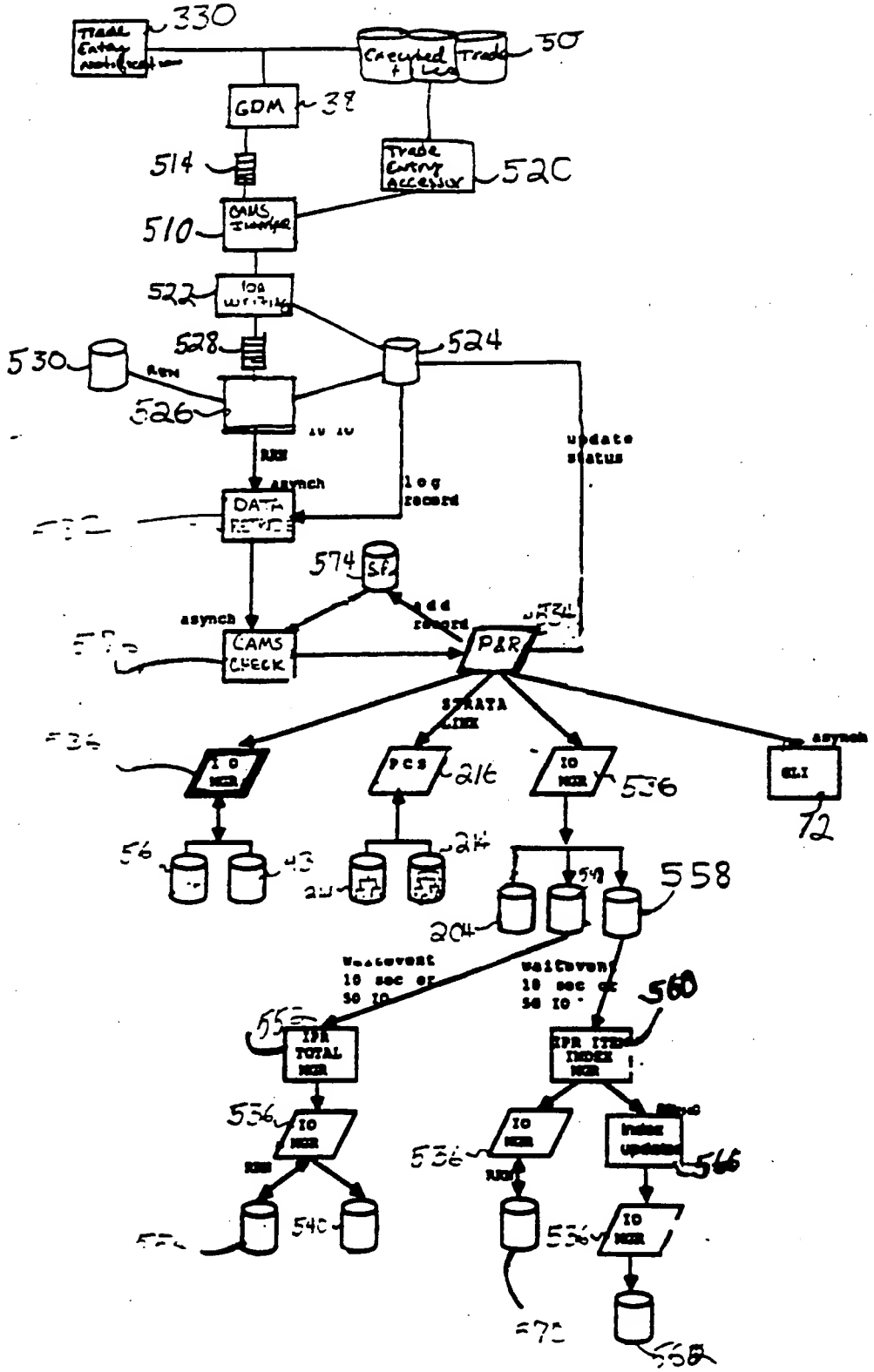
FIG12

Page 2


TRADE DATA (PC) DESK ENTRY FRONT-END MODULE
430
434
STRATUS QUEUE FOR DESK ENTRY
GDM
438
DESK ENTRY WAKE-UP MODULE
436
VALIDATION
439
DERIVATION
FIGURATION
440
GENERAL REFERENCE DATABASES
443
442
BOOK DESK TRADE
446
DESK TRADE LOG FILE
448
STORE & FORWARD LOG
UPDATER (BACKGROUND)
450
IO MANAGER MODULE
456
DESK ENTRY FILE
452
indexed


FLOOR ENTRY FILES
DESK ENTRY FILES
452
EXECUTED TRADE FILES
50
IO MANAGER MODULE
468
RECONCILIATION GATHER DATA MODULE
460
MATCH TRADE MODULE
470
GENERAL REFERENCE DATABASES
476
REPORTING MODULE
UNMATCHED TRADES ON ETF
474
REPORT
478


TRADE REQUEST INFO
480
38
GDM
484
RETRIEVE TRADE INFO
ID MANAGER MODULE
486
EXECUTED TRADE FILES
493
DISPLAY TRADE BY TRADE TYPE: EQUITY, FUTURE, OPTION, DEBT MORTGAGED - BAILED SECURITIES
MAINFRAME RESIDENT TRADE TABLES
490
SCREEN DISPLAY
492
DO UNTIL EXIT
506
TRADE MANAGEMENT REVIEW
494
CANCEL/ CORRECT HISTORY
498
MULTIPLE TRADE SEARCH
496
GIVE UP HISTORY
500
"WHEN ISSUE" HISTORY
502
ALL TRADES WITH SAME SEQUENCE NUMBER
504


330
Executed Trade
50
GDM
38
514
Trade Entry Accessor
520
CAMS Interface
510
IOA Writing
522
528
524
530
526
update status
log record
574
SP
add record
asynch
CAMS CHECK
P&R
STRATA LINK
I O MGR
PCS
216
IO MGR
536
GLI
72
56
43
214
204
558
560
IPR TOTAL MGR
IPR ITEM INDEX MGR
540
Index Update
546

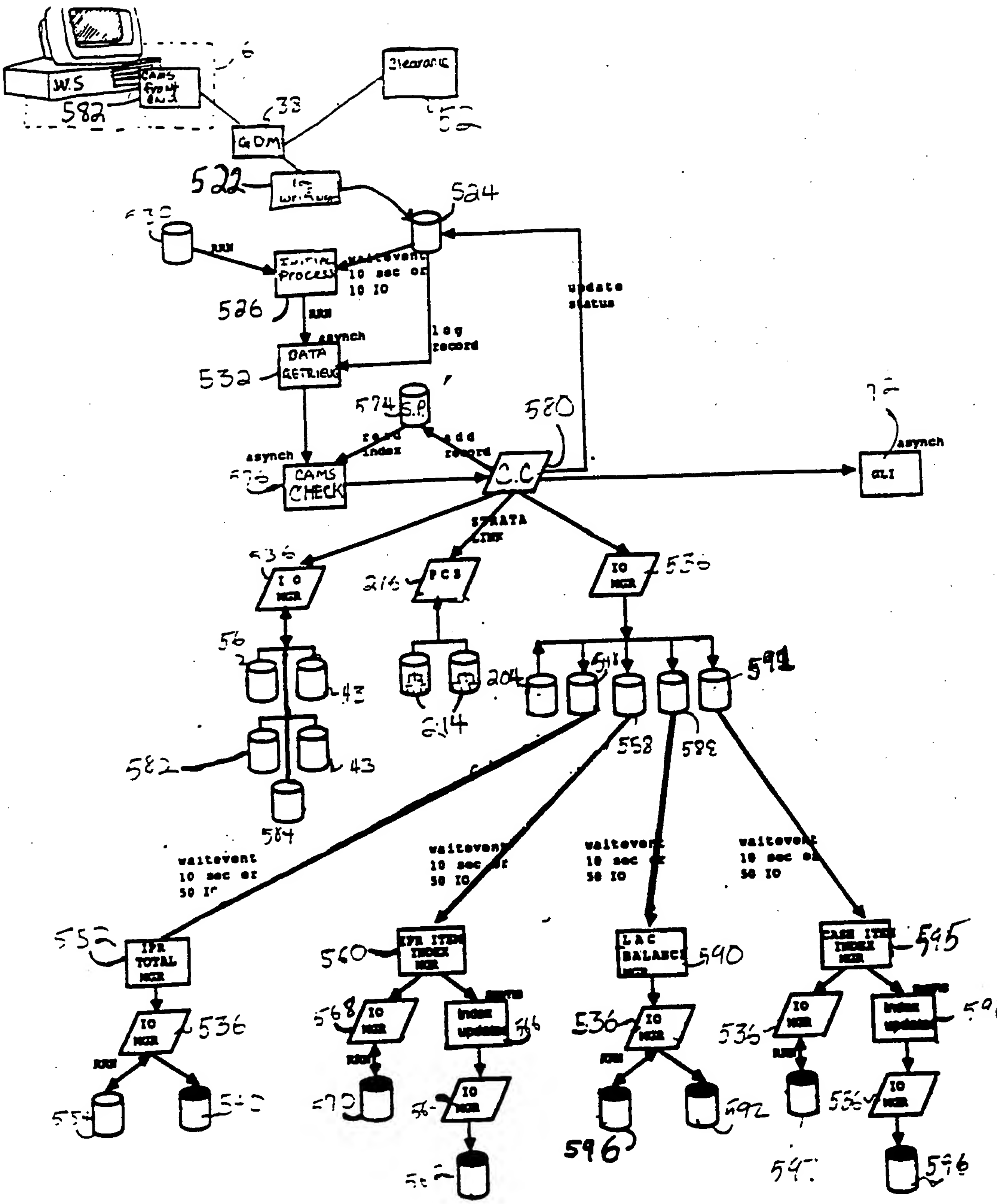
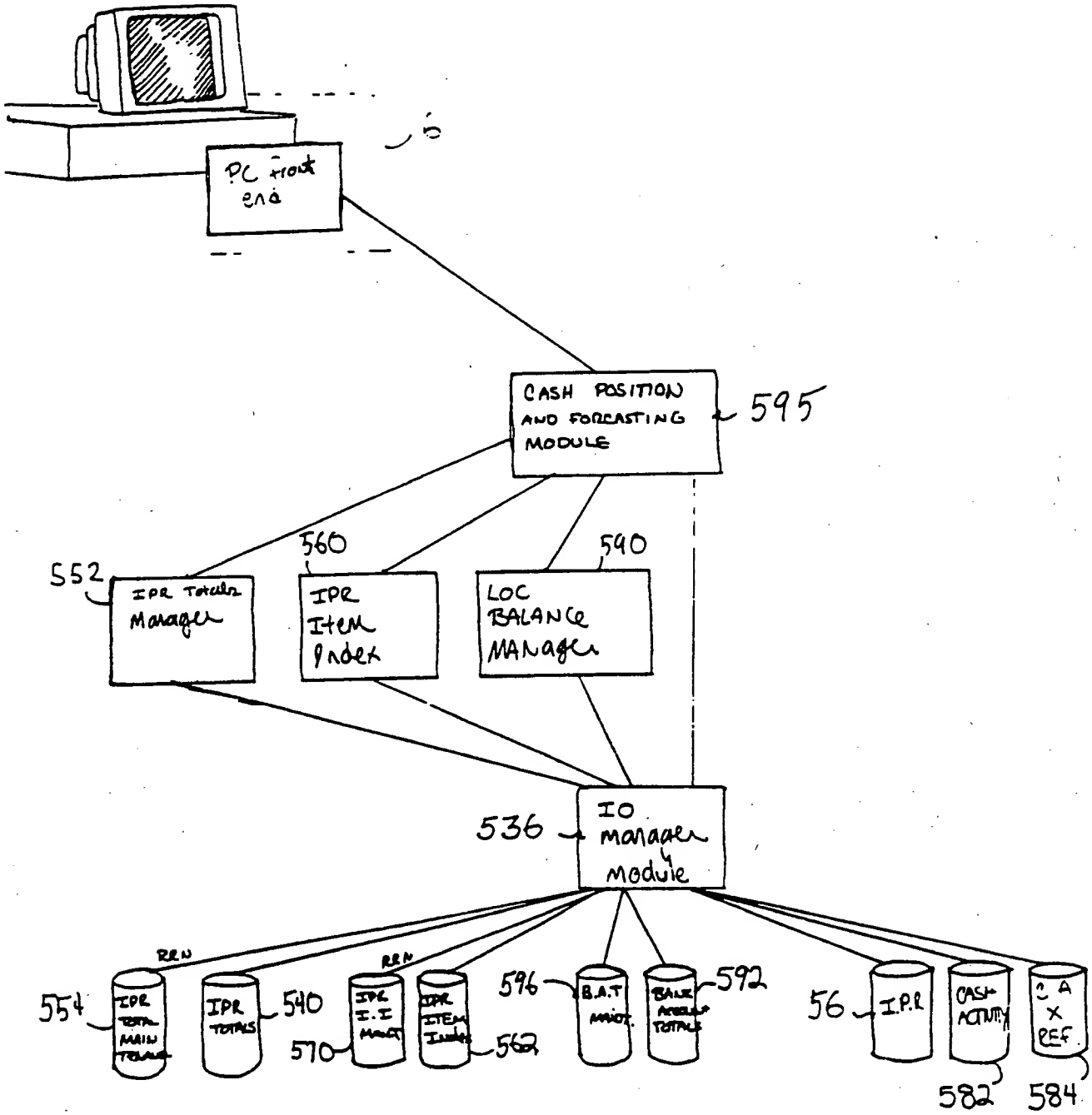

W.S
CAMS Front End
582
GDM
33
Clearance
52
522
524
Initial Process
waitevent 10 sec or 10 IO
526
RRN
asynch
log record
update status
DATA RETRIEVE
532
574
S.P.
read index
add record
580
asynch
CAMS CHECK
C.C
GLI
STRATA LINK
IO MGR
PCS
216
536
56
43
204
214
582
43
584
558
waitevent 10 sec or 50 IO
552
IPR TOTAL MGR
560
IPR ITEM INDEX MGR
LAC BALANCE MGR
590
CASE ITEM INDEX MGR
595
568
index update
536
592
596
596

FIG 16a


PC front end
CASH POSITION AND FORECASTING MODULE
595
552
IPR Totals Manager
560
IPR Item Index
590
LOC BALANCE MANAGER
536
IO Manager Module
RRN
554
IPR TOTAL MAIN TOTALS
IPR TOTALS
540
RRN
570
IPR I.I MAINT
IPR ITEM INDEX
562
596
B.A.T MAINT.
BALANCE ACCOUNT TOTALS
592
56
I.P.R
CASH ACTIVITY
582
C A X REF
584

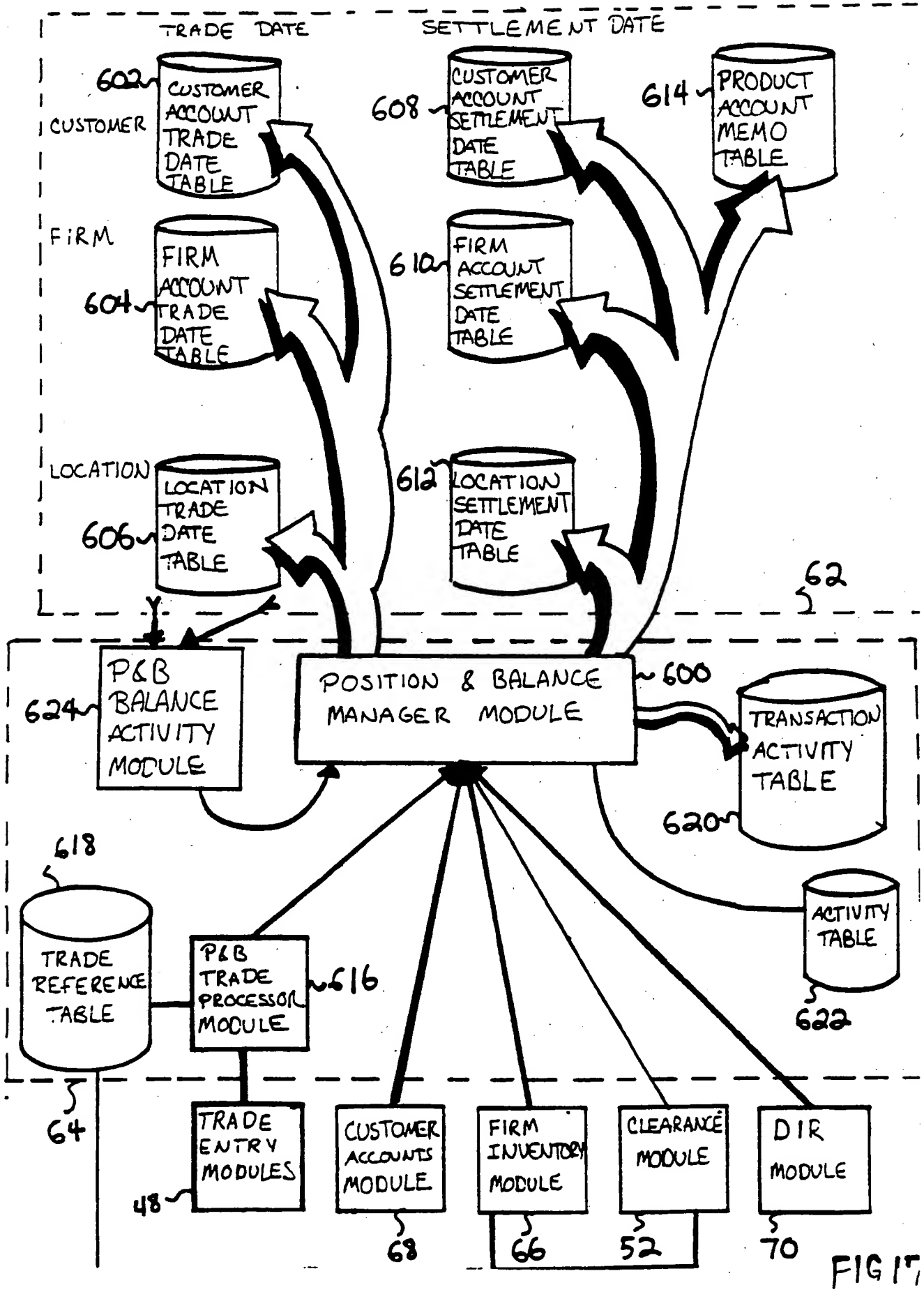

TRADE DATE
SETTLEMENT DATE
CUSTOMER
602
CUSTOMER ACCOUNT TRADE DATE TABLE
608
CUSTOMER ACCOUNT SETTLEMENT DATE TABLE
614
PRODUCT ACCOUNT MEMO TABLE
FIRM
604
FIRM ACCOUNT TRADE DATE TABLE
610
FIRM ACCOUNT SETTLEMENT DATE TABLE
LOCATION
606
LOCATION TRADE DATE TABLE
612
LOCATION SETTLEMENT DATE TABLE
62
624
P&B BALANCE ACTIVITY MODULE
POSITION & BALANCE MANAGER MODULE
600
TRANSACTION ACTIVITY TABLE
620
618
TRADE REFERENCE TABLE
P&B TRADE PROCESSOR MODULE
616
ACTIVITY TABLE
622
64
TRADE ENTRY MODULES
48
CUSTOMER ACCOUNTS MODULE
68
FIRM INVENTORY MODULE
66
CLEARANCE MODULE
52
DIR MODULE
70

FIG 17

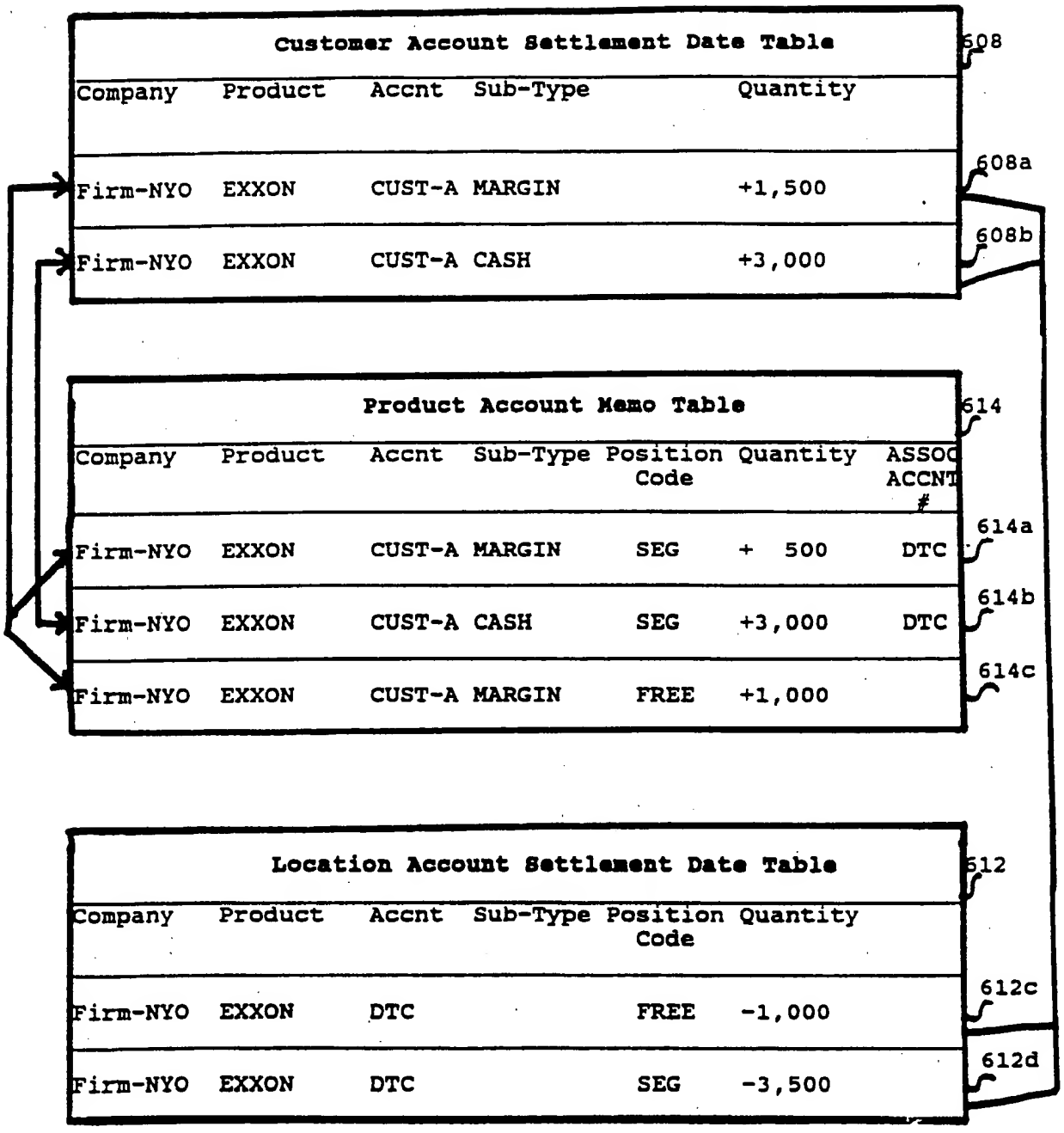
Firm Account Settlement Date Table 610

Company	Product	Account	Sub-Type	Quantity
Firm-NYO	USTB 1/18	TRD-ACCT-A		+5,000,000 610a

Location Settlement Date Table 612

Company	Product	Account	Sub-Type	Position Code	Quantity
Firm-NYO	USTB 1/18	IRV		FREE	-2,000,000 612a
Firm-NYO	USTB 1/18	MHT		FREE	-3,000,000 612b

FIG 18a



Customer Account Settlement Date Table — 608

Company	Product	Accnt	Sub-Type	Quantity
Firm-NYO	EXXON	CUST-A	MARGIN	+1,500
Firm-NYO	EXXON	CUST-A	CASH	+3,000

608a, 608b

Product Account Memo Table — 614

Company	Product	Accnt	Sub-Type	Position Code	Quantity	ASSOC ACCNT #
Firm-NYO	EXXON	CUST-A	MARGIN	SEG	+ 500	DTC
Firm-NYO	EXXON	CUST-A	CASH	SEG	+3,000	DTC
Firm-NYO	EXXON	CUST-A	MARGIN	FREE	+1,000	

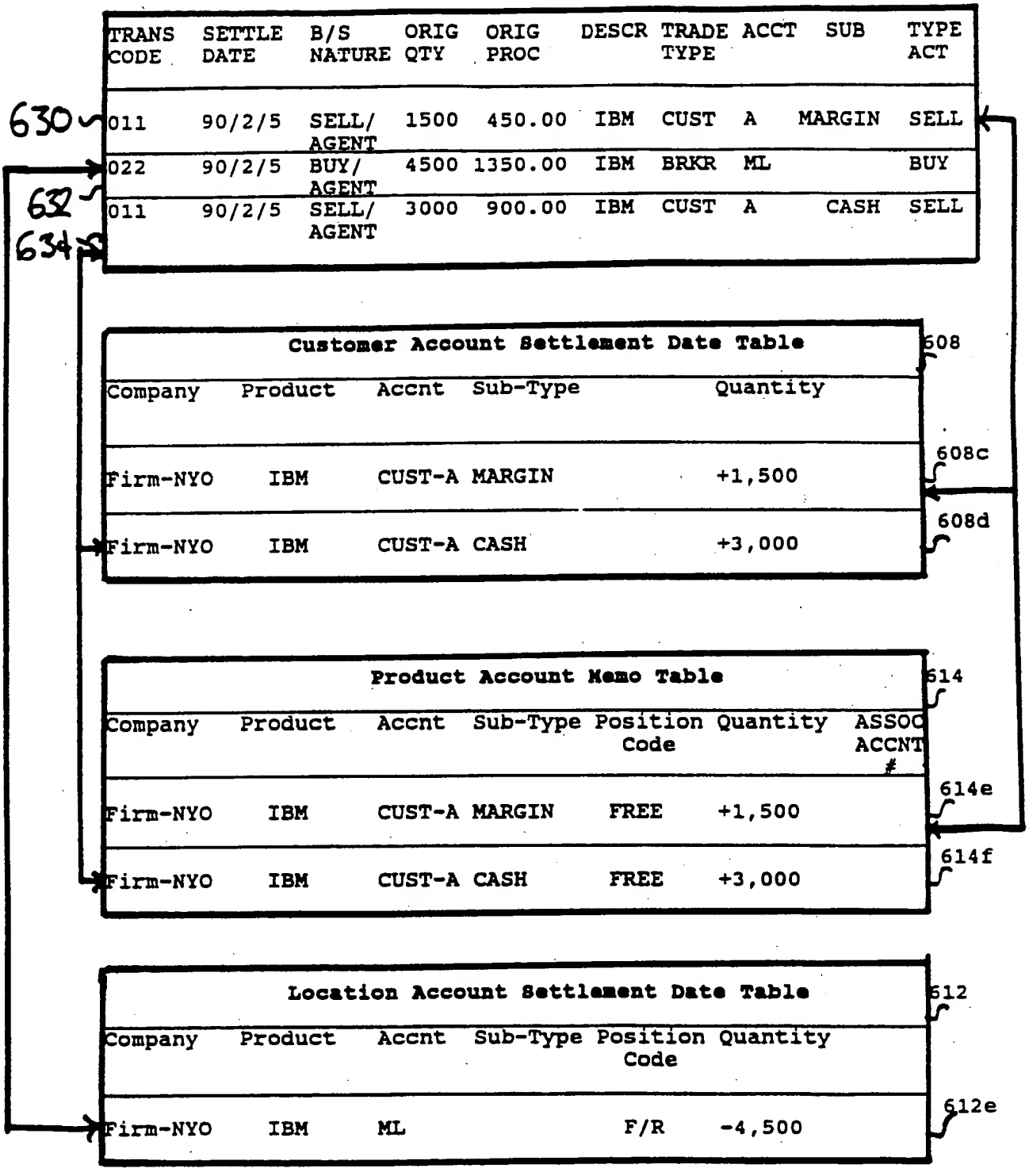
614a, 614b, 614c

Location Account Settlement Date Table — 612

Company	Product	Accnt	Sub-Type	Position Code	Quantity
Firm-NYO	EXXON	DTC		FREE	-1,000
Firm-NYO	EXXON	DTC		SEG	-3,500

612c, 612d

FIG 18b



TRANS CODE	SETTLE DATE	B/S NATURE	ORIG QTY	ORIG PROC	DESCR	TRADE TYPE	ACCT	SUB	TYPE ACT
011	90/2/5	SELL/ AGENT	1500	450.00	IBM	CUST	A	MARGIN	SELL
022	90/2/5	BUY/ AGENT	4500	1350.00	IBM	BRKR	ML		BUY
011	90/2/5	SELL/ AGENT	3000	900.00	IBM	CUST	A	CASH	SELL

630
632
634

Customer Account Settlement Date Table — 608

Company	Product	Accnt	Sub-Type	Quantity
Firm-NYO	IBM	CUST-A	MARGIN	+1,500
Firm-NYO	IBM	CUST-A	CASH	+3,000

608c
608d

Product Account Memo Table — 614

Company	Product	Accnt	Sub-Type	Position Code	Quantity	ASSOC ACCNT #
Firm-NYO	IBM	CUST-A	MARGIN	FREE	+1,500	
Firm-NYO	IBM	CUST-A	CASH	FREE	+3,000	

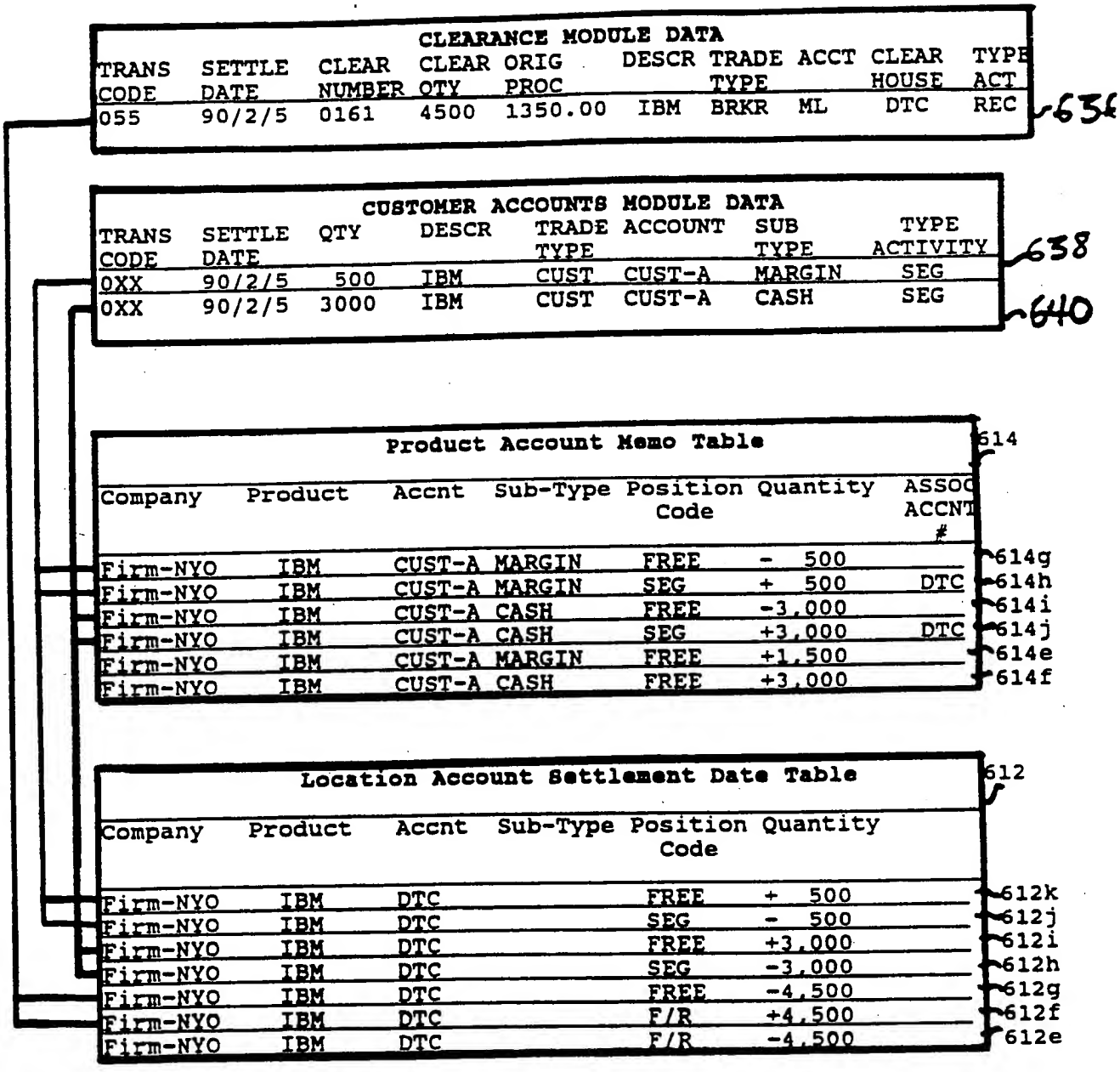
614e
614f

Location Account Settlement Date Table — 612

Company	Product	Accnt	Sub-Type	Position Code	Quantity
Firm-NYO	IBM	ML		F/R	-4,500

612e

FIG 18c



CLEARANCE MODULE DATA

TRANS CODE	SETTLE DATE	CLEAR NUMBER	CLEAR QTY	ORIG PROC	DESCR	TRADE TYPE	ACCT	CLEAR HOUSE	TYPE ACT
055	90/2/5	0161	4500	1350.00	IBM	BRKR	ML	DTC	REC

636

CUSTOMER ACCOUNTS MODULE DATA

TRANS CODE	SETTLE DATE	QTY	DESCR	TRADE TYPE	ACCOUNT	SUB TYPE	TYPE ACTIVITY
0XX	90/2/5	500	IBM	CUST	CUST-A	MARGIN	SEG
0XX	90/2/5	3000	IBM	CUST	CUST-A	CASH	SEG

638

640

Product Account Memo Table — 614

Company	Product	Accnt	Sub-Type	Position Code	Quantity	ASSOC ACCNT #	
Firm-NYO	IBM	CUST-A	MARGIN	FREE	- 500		614g
Firm-NYO	IBM	CUST-A	MARGIN	SEG	+ 500	DTC	614h
Firm-NYO	IBM	CUST-A	CASH	FREE	-3,000		614i
Firm-NYO	IBM	CUST-A	CASH	SEG	+3,000	DTC	614j
Firm-NYO	IBM	CUST-A	MARGIN	FREE	+1,500		614e
Firm-NYO	IBM	CUST-A	CASH	FREE	+3,000		614f

Location Account Settlement Date Table — 612

Company	Product	Accnt	Sub-Type	Position Code	Quantity	
Firm-NYO	IBM	DTC		FREE	+ 500	612k
Firm-NYO	IBM	DTC		SEG	- 500	612j
Firm-NYO	IBM	DTC		FREE	+3,000	612i
Firm-NYO	IBM	DTC		SEG	-3,000	612h
Firm-NYO	IBM	DTC		FREE	-4,500	612g
Firm-NYO	IBM	DTC		F/R	+4,500	612f
Firm-NYO	IBM	DTC		F/R	-4,500	612e

FIG 18d

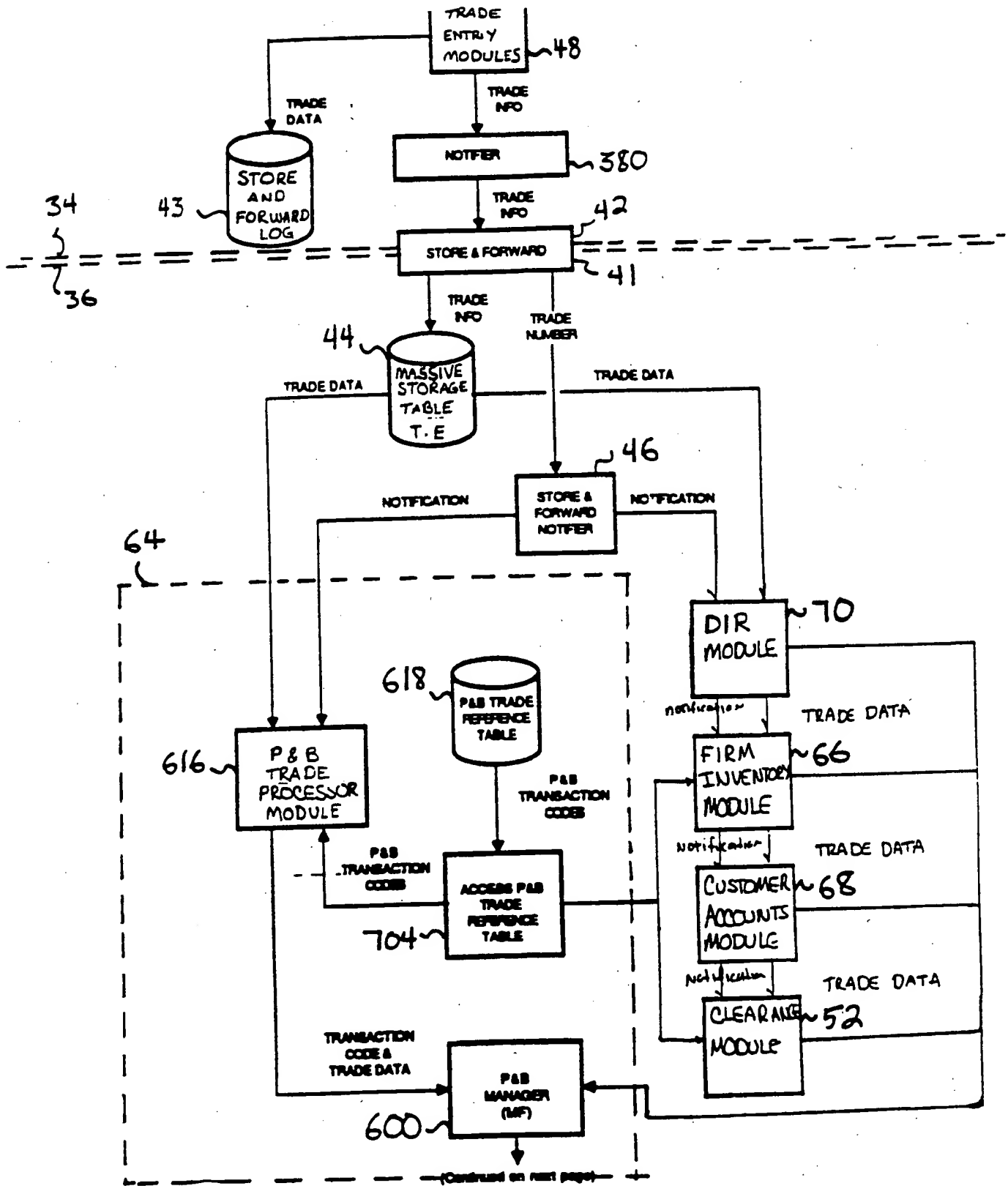


FIG 19a
Page 1

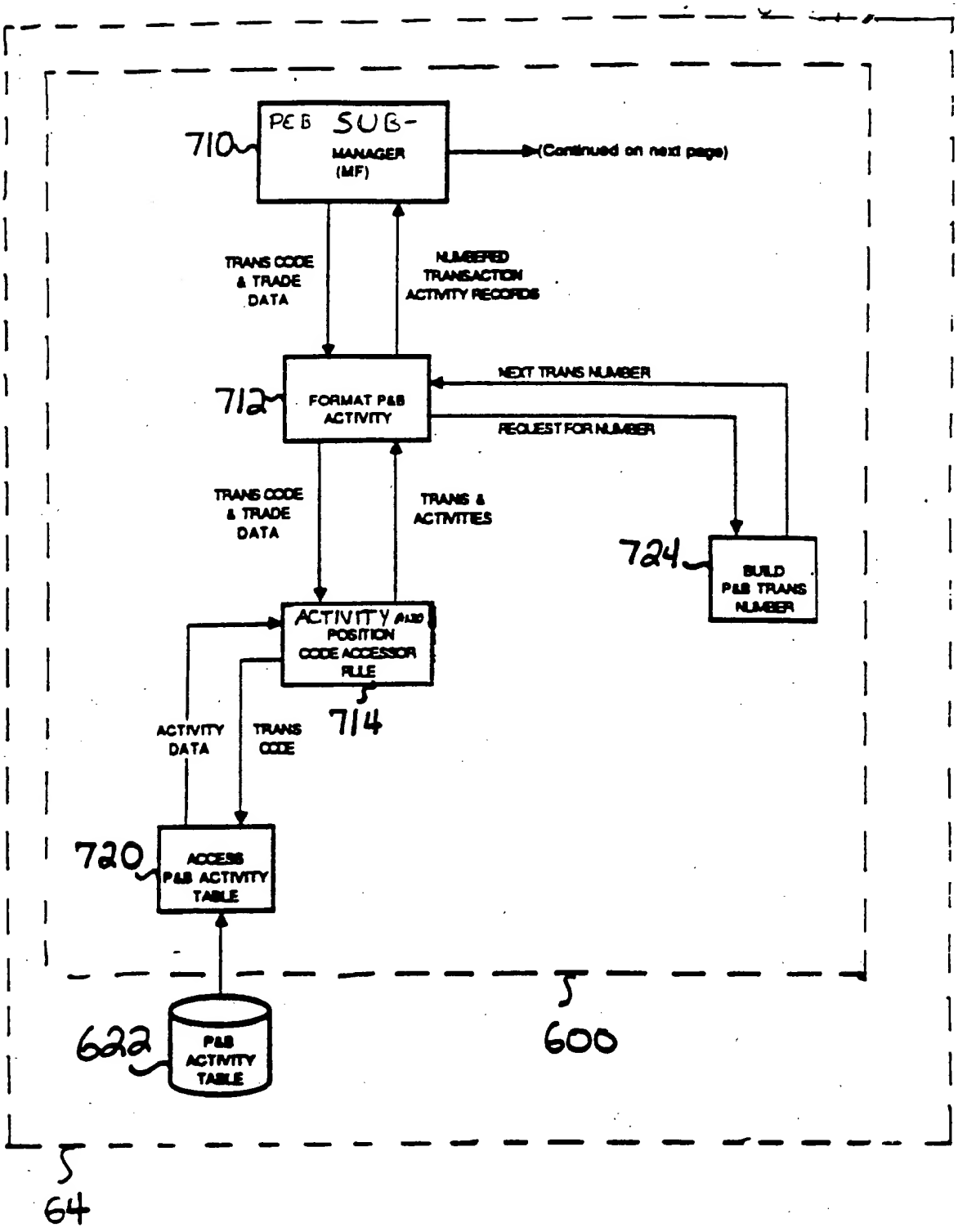

710
P&B SUB-MANAGER (MF)
(Continued on next page)
TRANS CODE & TRADE DATA
NUMBERED TRANSACTION ACTIVITY RECORDS
712
FORMAT P&B ACTIVITY
NEXT TRANS NUMBER
REQUEST FOR NUMBER
TRANS CODE & TRADE DATA
TRANS & ACTIVITIES
724
BUILD P&B TRANS NUMBER
ACTIVITY POSITION CODE ACCESSOR FILE
714
ACTIVITY DATA
TRANS CODE
720
ACCESS P&B ACTIVITY TABLE
622
P&B ACTIVITY TABLE
600
64

FIG 19
PAGE 2

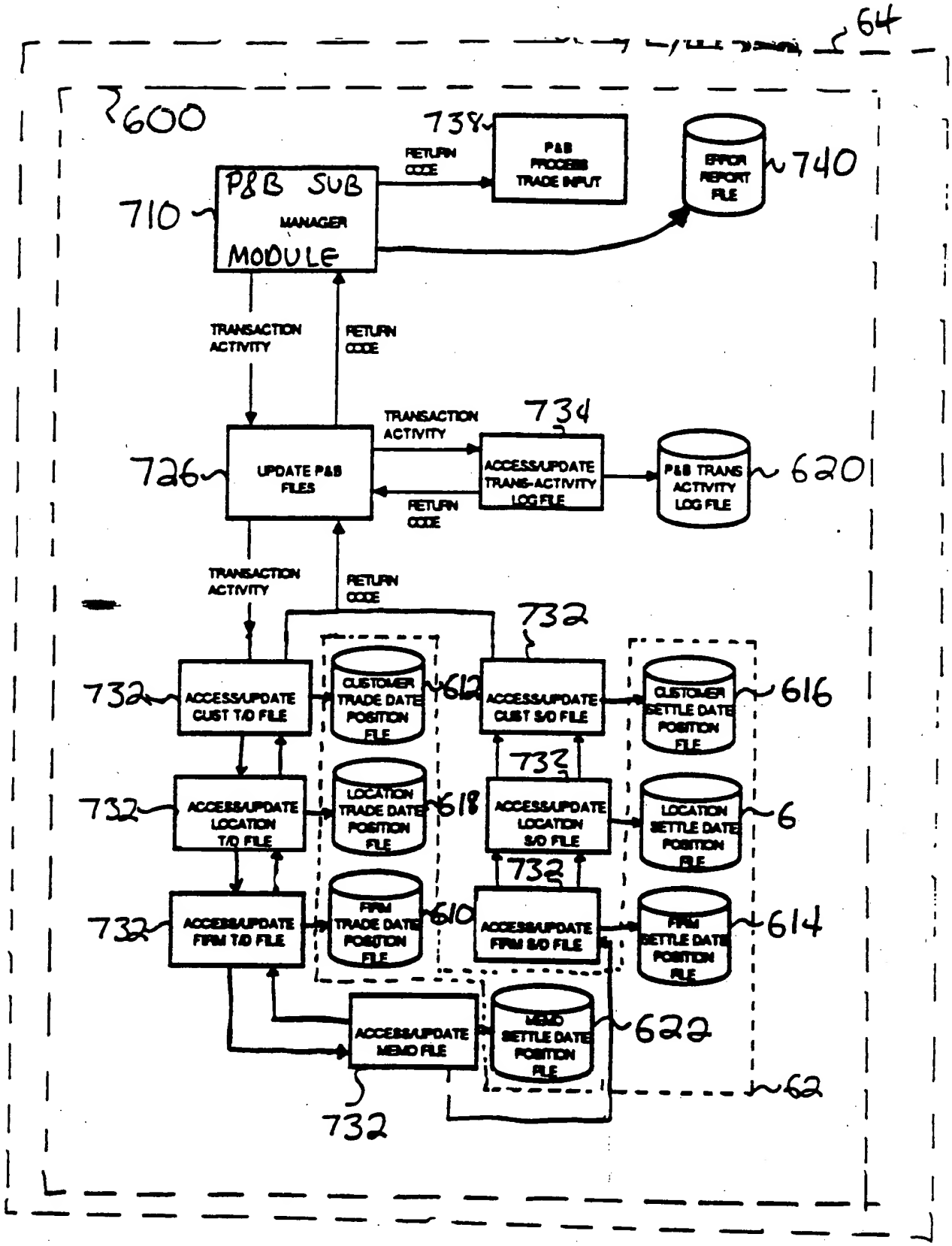


FIG 19a
PAGE3

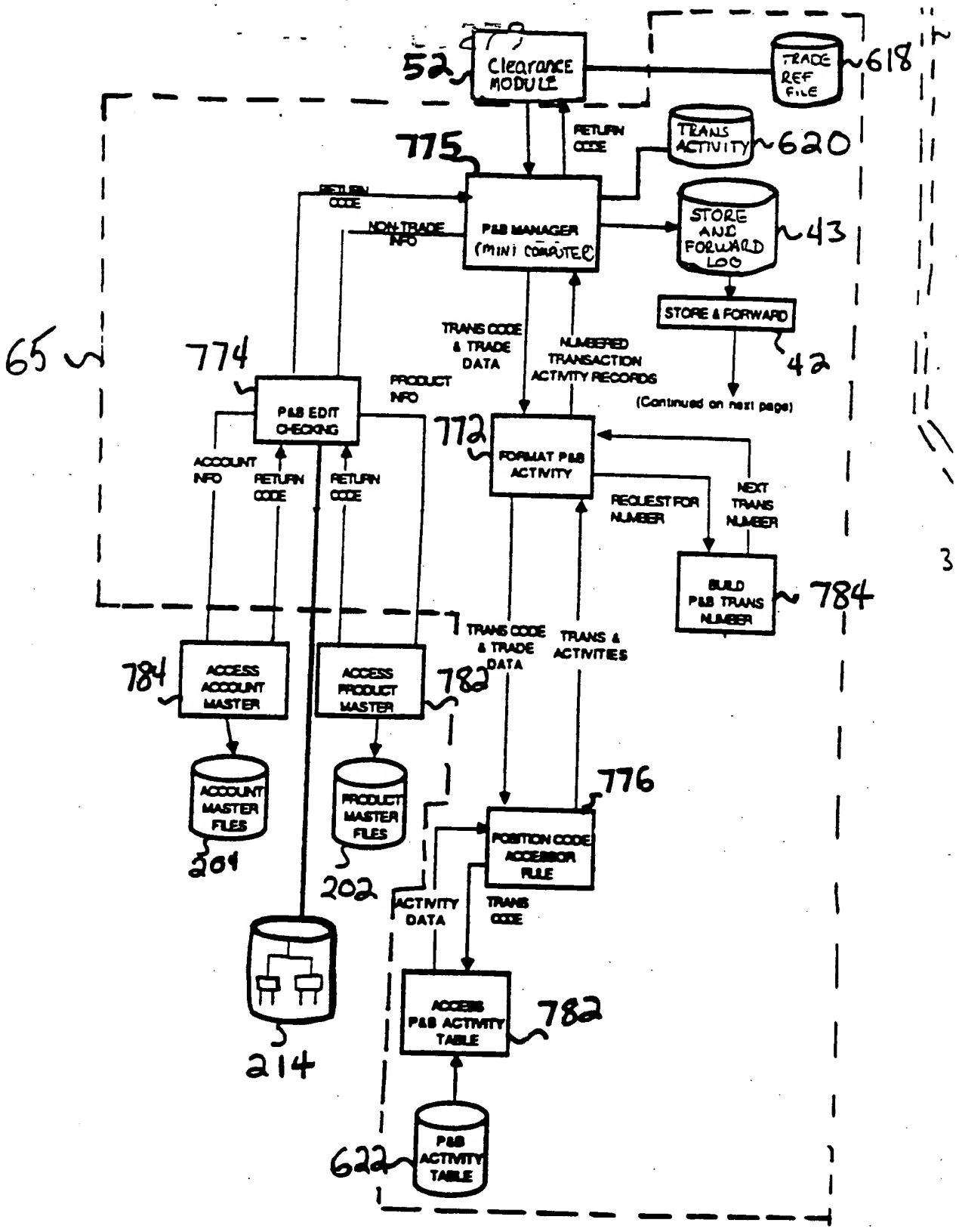

52
Clearance MODULE
618
TRADE REF FILE
775
RETURN CODE
TRANS ACTIVITY
620
RETURN CODE
NON-TRADE INFO
P&B MANAGER (MINI COMPUTER)
STORE AND FORWARD LOG
43
STORE & FORWARD
42
65
774
TRANS CODE & TRADE DATA
NUMBERED TRANSACTION ACTIVITY RECORDS
(Continued on next page)
P&B EDIT CHECKING
PRODUCT INFO
772
FORMAT P&B ACTIVITY
ACCOUNT INFO
RETURN CODE
RETURN CODE
REQUEST FOR NUMBER
NEXT TRANS NUMBER
BUILD P&B TRANS NUMBER
784
TRANS CODE & TRADE DATA
TRANS & ACTIVITIES
784
ACCESS ACCOUNT MASTER
ACCESS PRODUCT MASTER
782
ACCOUNT MASTER FILES
201
PRODUCT MASTER FILES
202
776
POSITION CODE ACCESSOR FILE
ACTIVITY DATA
TRANS CODE
214
ACCESS P&B ACTIVITY TABLE
782
622
P&B ACTIVITY TABLE

FIG 19
PAGE 1

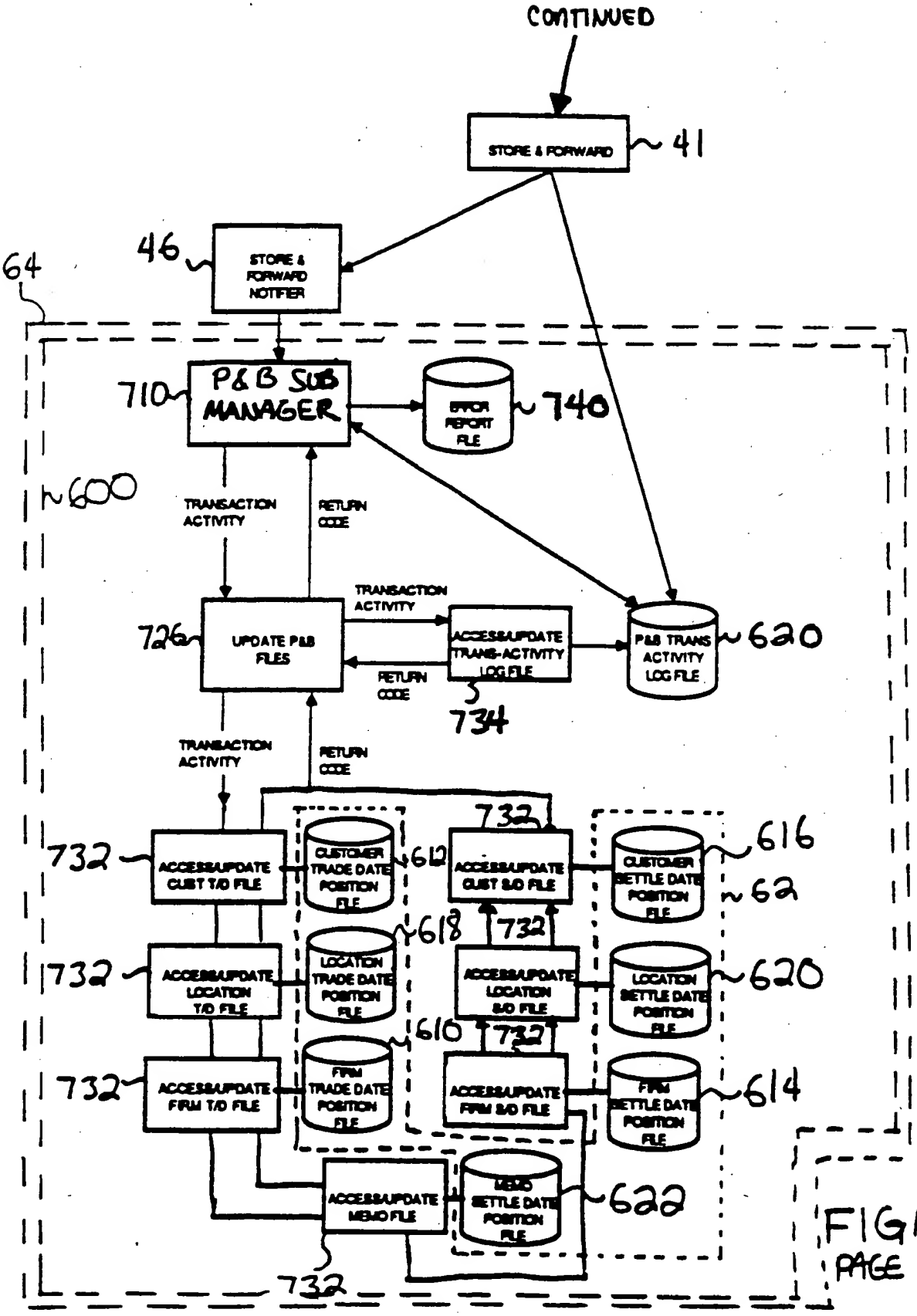

CONTINUED
STORE & FORWARD
41
46
STORE & FORWARD NOTIFIER
64
710
P&B SUB MANAGER
ERROR REPORT FILE
740
600
TRANSACTION ACTIVITY
RETURN CODE
726
UPDATE P&B FILES
ACCESS/UPDATE TRANS-ACTIVITY LOG FILE
734
P&B TRANS ACTIVITY LOG FILE
620
732
ACCESS/UPDATE CUST T/D FILE
CUSTOMER TRADE DATE POSITION FILE
612
ACCESS/UPDATE CUST S/D FILE
CUSTOMER SETTLE DATE POSITION FILE
616
62
618
ACCESS/UPDATE LOCATION T/D FILE
LOCATION TRADE DATE POSITION FILE
ACCESS/UPDATE LOCATION S/D FILE
LOCATION SETTLE DATE POSITION FILE
610
ACCESS/UPDATE FIRM T/D FILE
FIRM TRADE DATE POSITION FILE
ACCESS/UPDATE FIRM S/D FILE
FIRM SETTLE DATE POSITION FILE
614
ACCESS/UPDATE MEMO FILE
MEMO SETTLE DATE POSITION FILE
622

FIG 19
PAGE 2

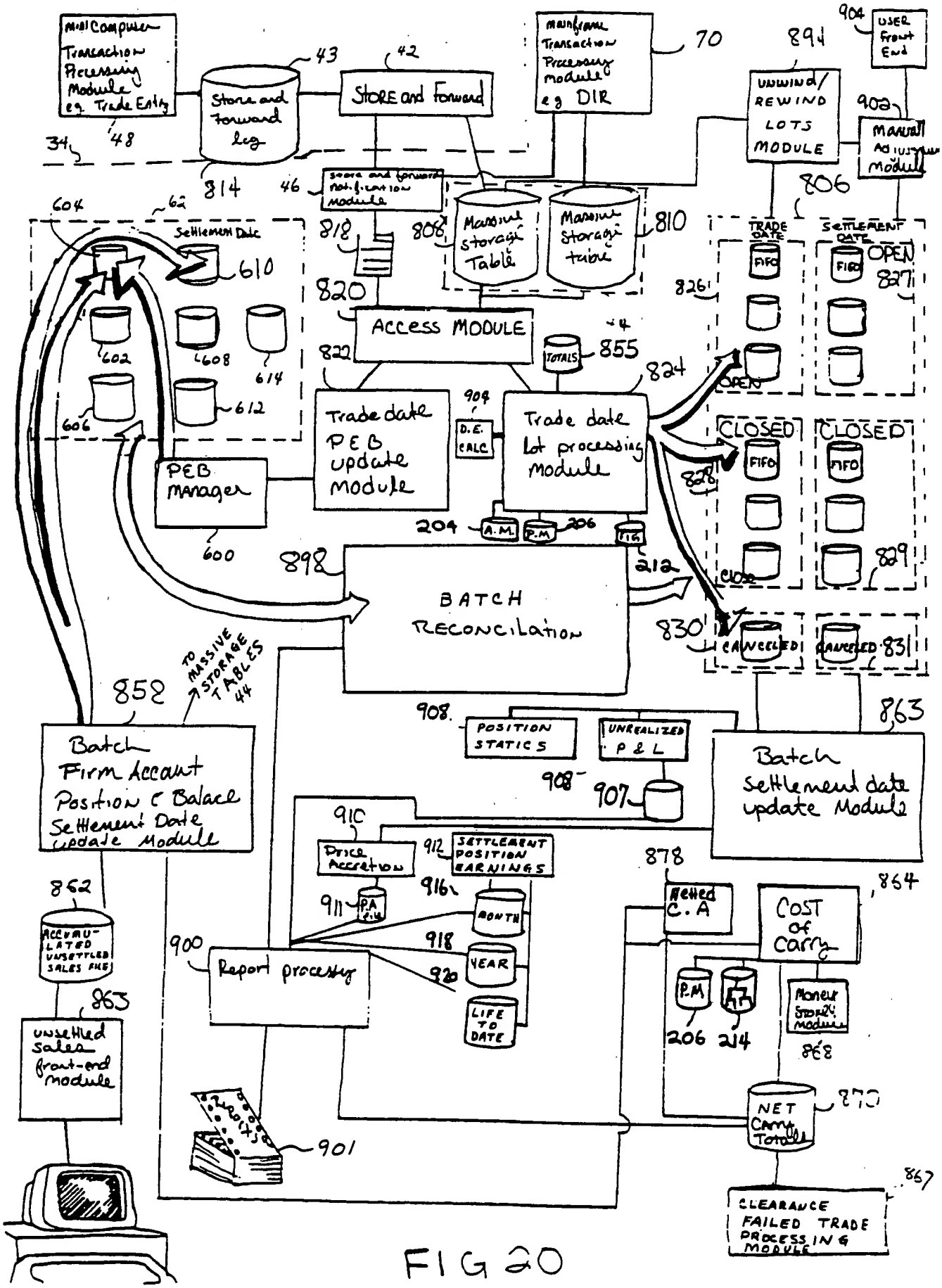

Mid Computer Transaction Processing Module eg. Trade Entry
48
34
43
Store and forward leg
814
42
STORE and Forward
Mainframe Transaction Processing module eg DIR
70
894
UNWIND/ REWIND LOTS MODULE
904
USER Front End
903
MANUAL ADJUSTMENT Module
806
Store and forward notification module
46
818
820
806
Massive storage Table
Massive storage table
810
604
62
Settlement Date
610
602
608
614
606
612
ACCESS MODULE
822
855
TOTALS
824
Trade date PEB update module
PEB manager
600
909
D.E. CALC
Trade date lot processing module
204
A.M.
P.M.
206
TIG
212
898
BATCH RECONCILATION
TRADE DATE
SETTLEMENT DATE
FIFO
OPEN
827
826
CLOSED
828
829
CLOSE
830
CANCELLED
831
TO MASSIVE STORAGE TABLES 44
858
Batch Firm Account Position & Balance Settlement Date Update Module
908
POSITION STATICS
UNREALIZED P & L
907
863
Batch Settlement date update Module
910
Price Accretion
912
SETTLEMENT POSITION EARNINGS
911
P.A. 214
916
MONTH
YEAR
LIFE TO DATE
918
920
900
Report processing
878
Netted C.A
864
COST of Carry
P.M
206
214
Money Storage Module
868
862
ACCUMULATED UNSETTLED SALES FILE
863
UNSETTLED Sales front-end module
901
NET Carry Totals
870
867
CLEARANCE FAILED TRADE PROCESSING MODULE

FIG 20

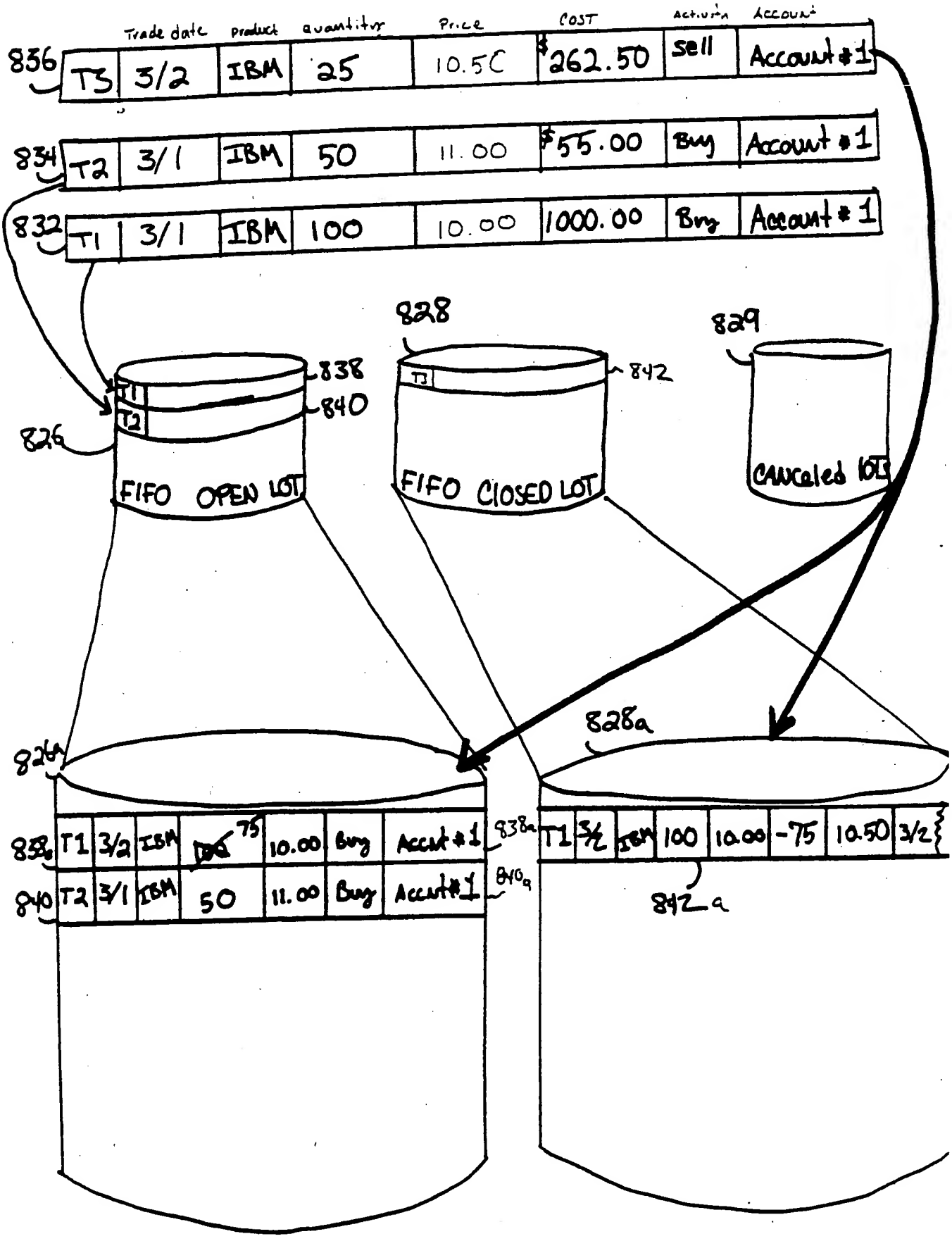

Trade date
product
quantity
Price
COST
Activity
Account
836
T3 3/2 IBM 25 10.50 $262.50 sell Account #1
834
T2 3/1 IBM 50 11.00 $55.00 Buy Account #1
832
T1 3/1 IBM 100 10.00 1000.00 Buy Account #1
828
829
838
840
842
826
T1
T2
T3
FIFO OPEN LOT
FIFO CLOSED LOT
CANCELED LOT
828a
826a
838a
840a
842a
T1 3/2 IBM 75 10.00 Buy Accnt #1
T2 3/1 IBM 50 11.00 Buy Accnt #1
T1 3/2 IBM 100 10.00 -75 10.50 3/2

FIG 20a

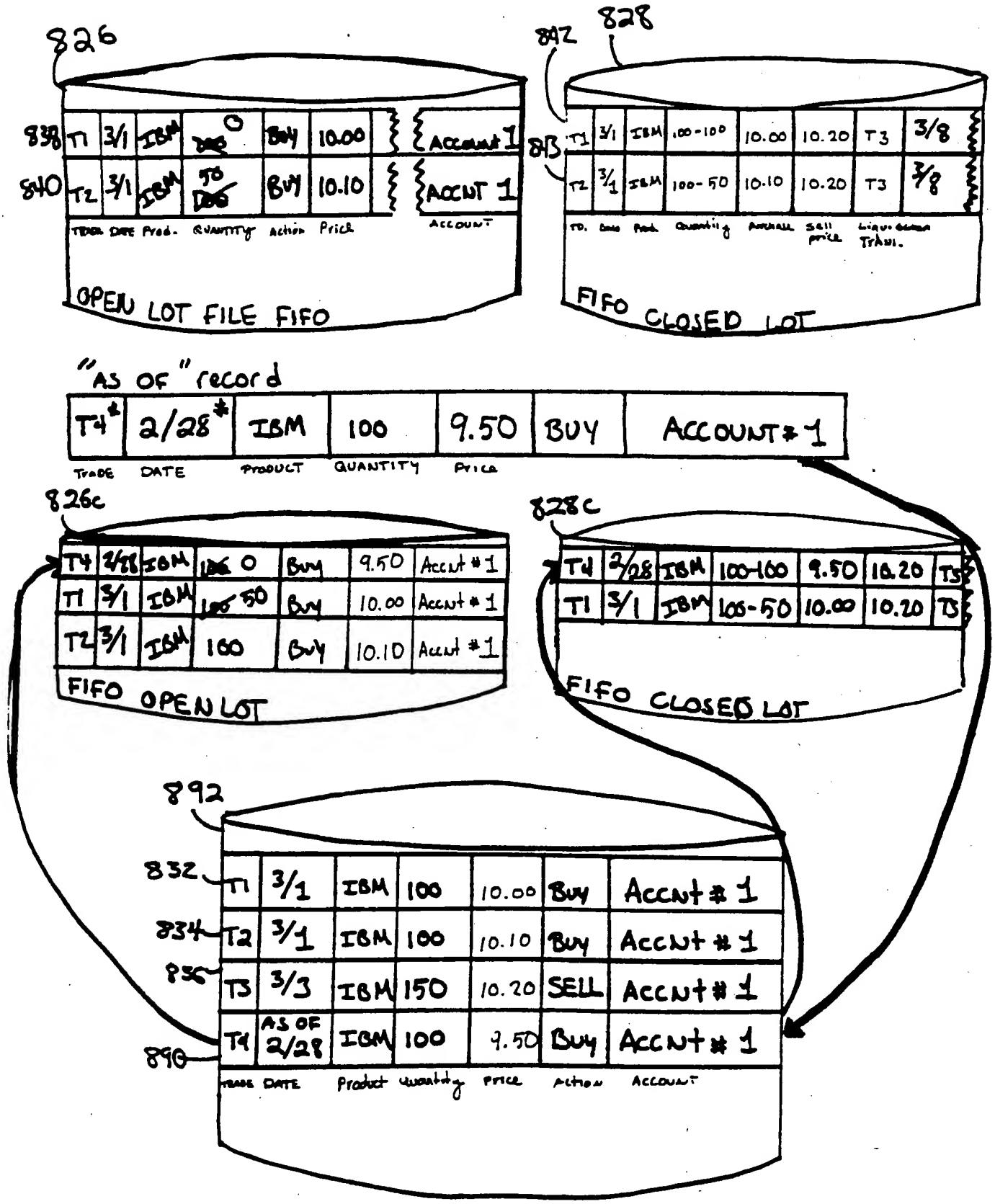

826
838
840
T1 3/1 IBM 0 Buy 10.00 Account 1
T2 3/1 IBM 50 Buy 10.10 ACCNT 1
TRADE DATE Prod. QUANTITY Action Price ACCOUNT
OPEN LOT FILE FIFO
842
828
843
T1 3/1 IBM 100-100 10.00 10.20 T3 3/8
T2 3/1 IBM 100-50 10.10 10.20 T3 3/8
FIFO CLOSED LOT
"AS OF" record
T4 2/28 IBM 100 9.50 BUY ACCOUNT # 1
TRADE DATE PRODUCT QUANTITY PRICE
826c
T4 2/28 IBM 100 0 Buy 9.50 Accnt # 1
T1 3/1 IBM 100 50 Buy 10.00 Accnt # 1
T2 3/1 IBM 100 Buy 10.10 Accnt # 1
FIFO OPEN LOT
828c
T4 2/28 IBM 100-100 9.50 10.20 T3
T1 3/1 IBM 100-50 10.00 10.20 T3
FIFO CLOSED LOT
892
832
834
836
890
T1 3/1 IBM 100 10.00 Buy Accnt # 1
T2 3/1 IBM 100 10.10 Buy Accnt # 1
T3 3/3 IBM 150 10.20 SELL Accnt # 1
T4 AS OF 2/28 IBM 100 9.50 Buy Accnt # 1
TRADE DATE Product Quantity PRICE Action ACCOUNT

FIG 20b

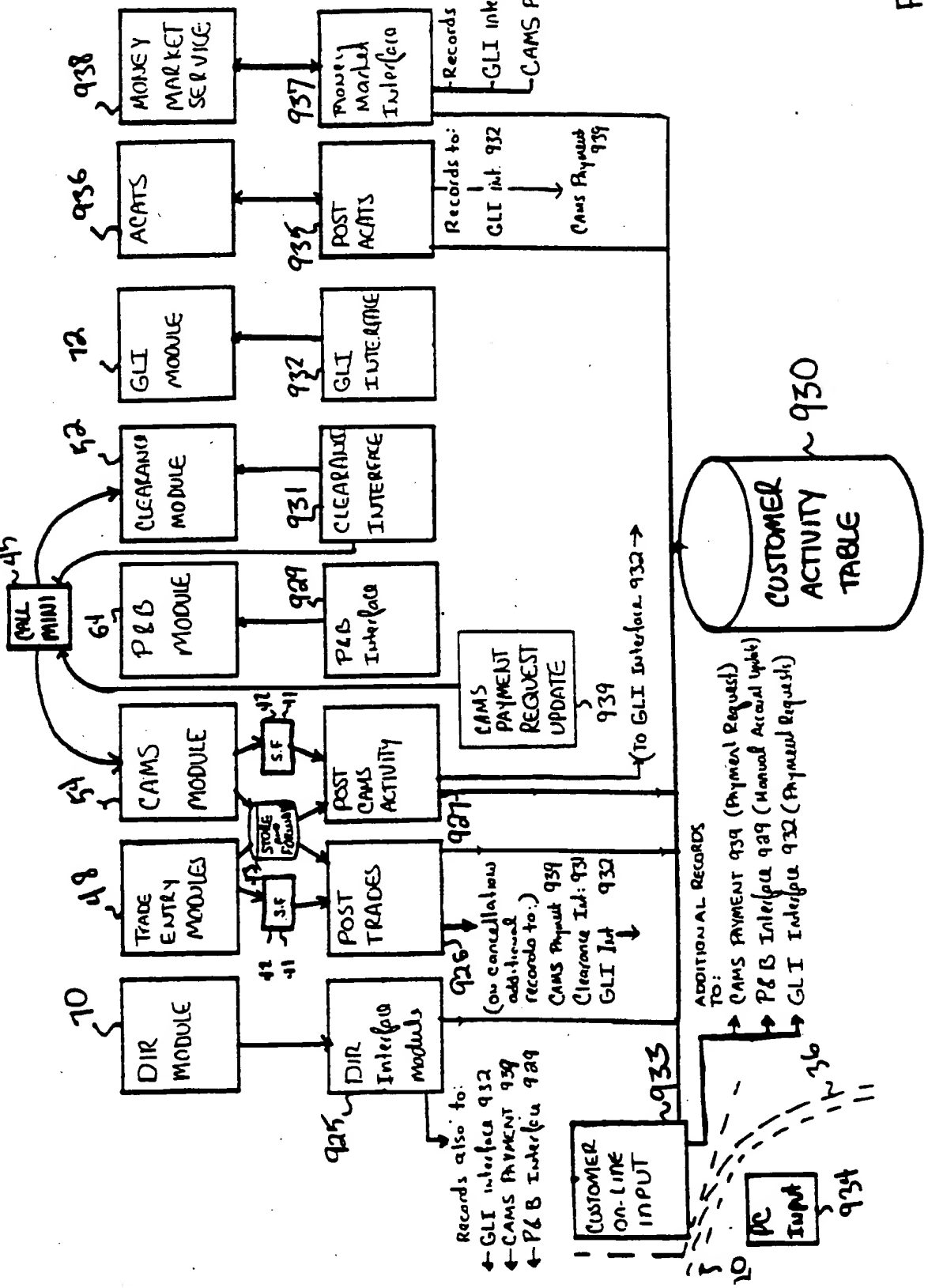
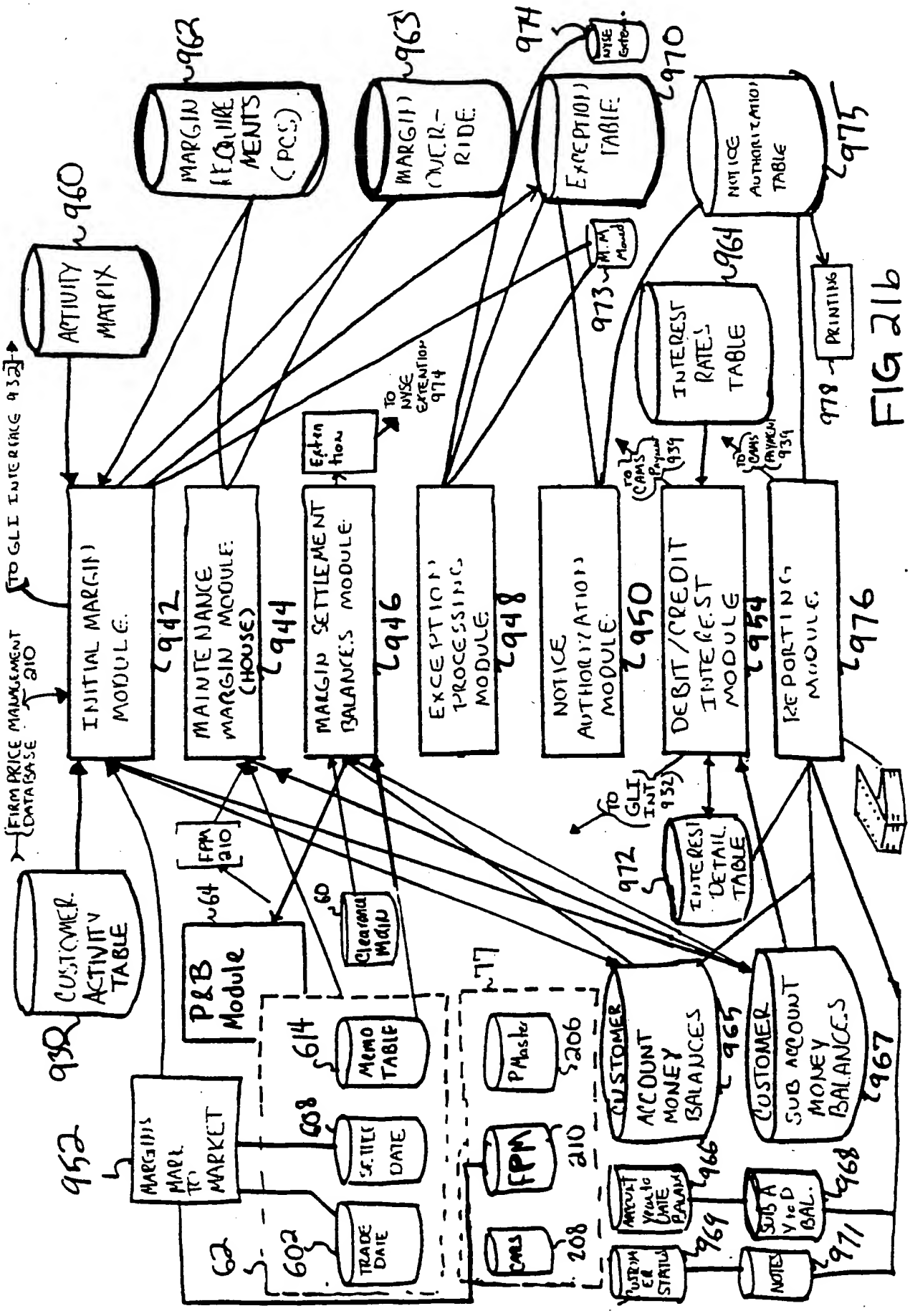

DIR MODULE
70
DIR Interface modules
925
TRADE ENTRY MODULES
49
POST TRADES
926
CAMS MODULE
54
POST CAMS ACTIVITY
927
CLEARANCE MODULE
52
CLEARANCE INTERFACE
931
GLI MODULE
72
GLI INTERFACE
932
ACATS
936
POST ACATS
935
MONEY MARKET SERVICE
938
Money Market Interface
937
P&B MODULE
61
P&B Interface
929
CALL MINI
45
S.F
STOCK FORWARD
CAMS PAYMENT REQUEST UPDATE
939
(To GLI Interface 932 →
CUSTOMER ACTIVITY TABLE
930
Records also to:
GLI interface 932 →
CAMS Payment 939
Records to:
GLI Int. 932
Cams Payment 939
Records also to:
← GLI Interface 932
← CAMS PAYMENT 939
← P&B Interface 929
(on cancellation additional records to:)
CAMS Payment 939
Clearance Int: 931
GLI Int 932
ADDITIONAL RECORDS TO:
CAMS PAYMENT 939 (Payment Request)
P&B Interface 929 (Manual Accrual Update)
GLI Interface 932 (Payment Request)
933
CUSTOMER ON-LINE INPUT
PC Input
934
10
36

FIG 21a


962
MARGIN REQUIREMENTS (PCS)
963
MARGIN (OVERRIDE
974
EXCEPTION TABLE
970
NOTICE AUTHORIZATION TABLE
975
960
ACTIVITY MATRIX
964
INTEREST RATES TABLE
973
M.M. Model
979
PRINTING
TO GLI INTERFACE 934
FIRM PRICE MAINTENANCE 210
INITIAL MARGIN MODULE
942
MAINTENANCE MARGIN MODULE (HOUSE)
944
MARGIN SETTLEMENT BALANCES MODULE
946
EXCEPTION PROCESSING MODULE
948
NOTICE AUTHORIZATION MODULE
950
DEBIT/CREDIT INTEREST MODULE
954
REPORTING MODULE
976
TO NYSE EXTENTION 974
Extension
TO CAMS PAYMENT 939
TO CAMS PAYMENT 939
FIRM PRICE DATABASE
CUSTOMER ACTIVITY TABLE
932
952
MARGINS MARK TO MARKET
P&B Module
964
FPM 210
Clearance Main
90
614
MEMO TABLE
608
SETTLE DATE
602
TRADE DATE
62
977
PMaster
206
FPM
210
CMS
208
CUSTOMER ACCOUNT MONEY BALANCES
965
CUSTOMER SUB ACCOUNT MONEY BALANCES
967
TO GLI INT 952
972
INTEREST DETAIL TABLE
AMOUNT YTD/10 DATE BAL
966
SUB A YTD BAL.
968
CUSTOMER STATUS
969
NOTES
971
FIG 21b

I. TRADE GETS BOOKED (a)

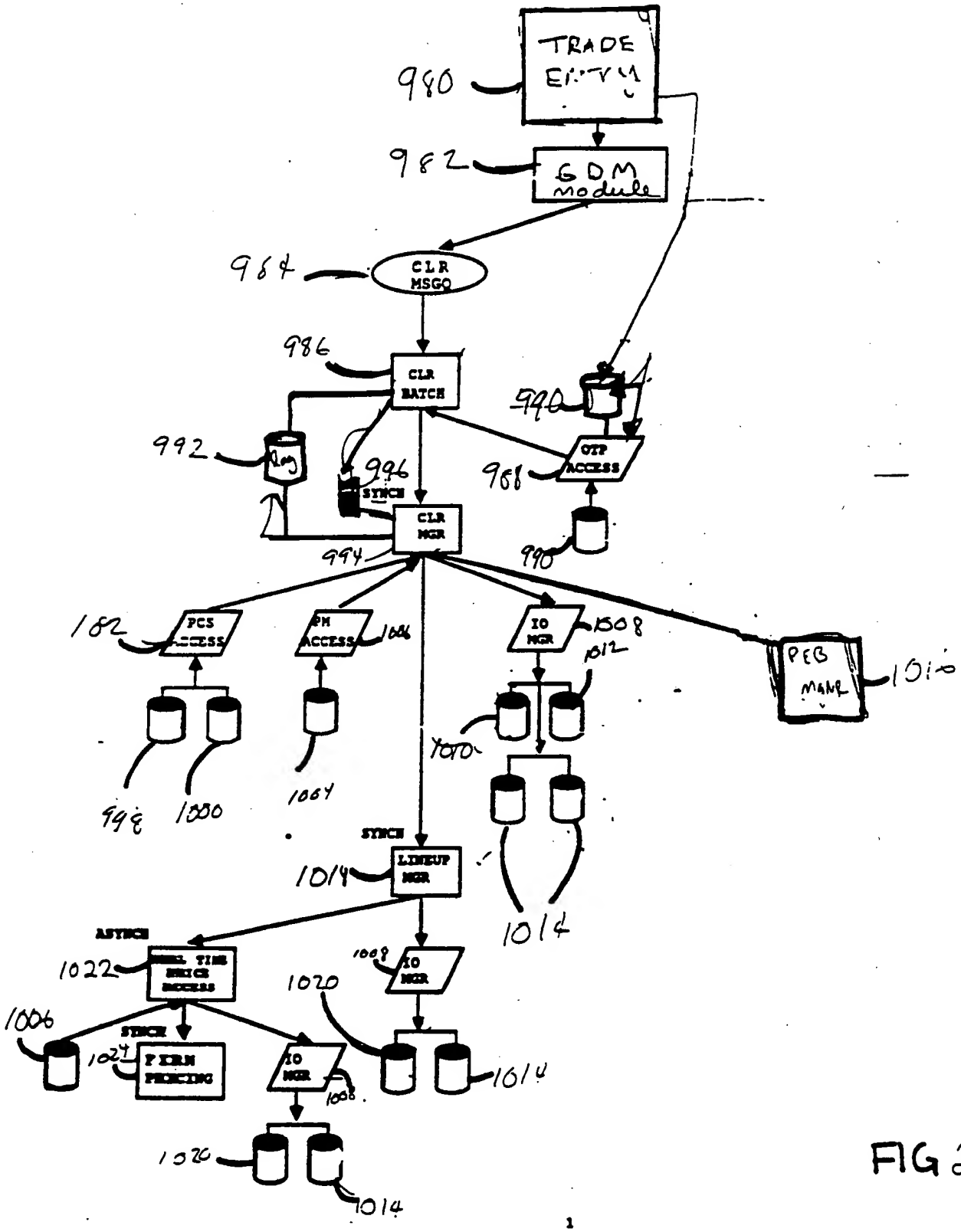


FIG 22a

Trade Gets Paired Off

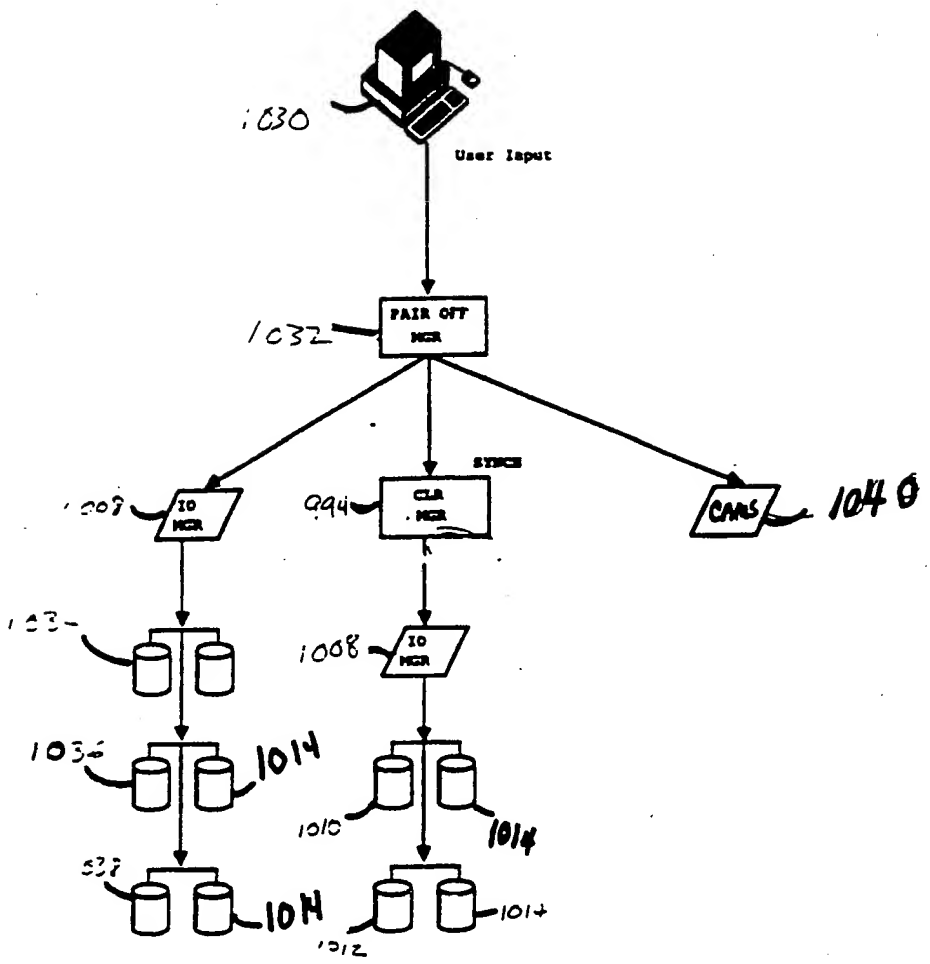


FIG 22b

TRADE CLEARS

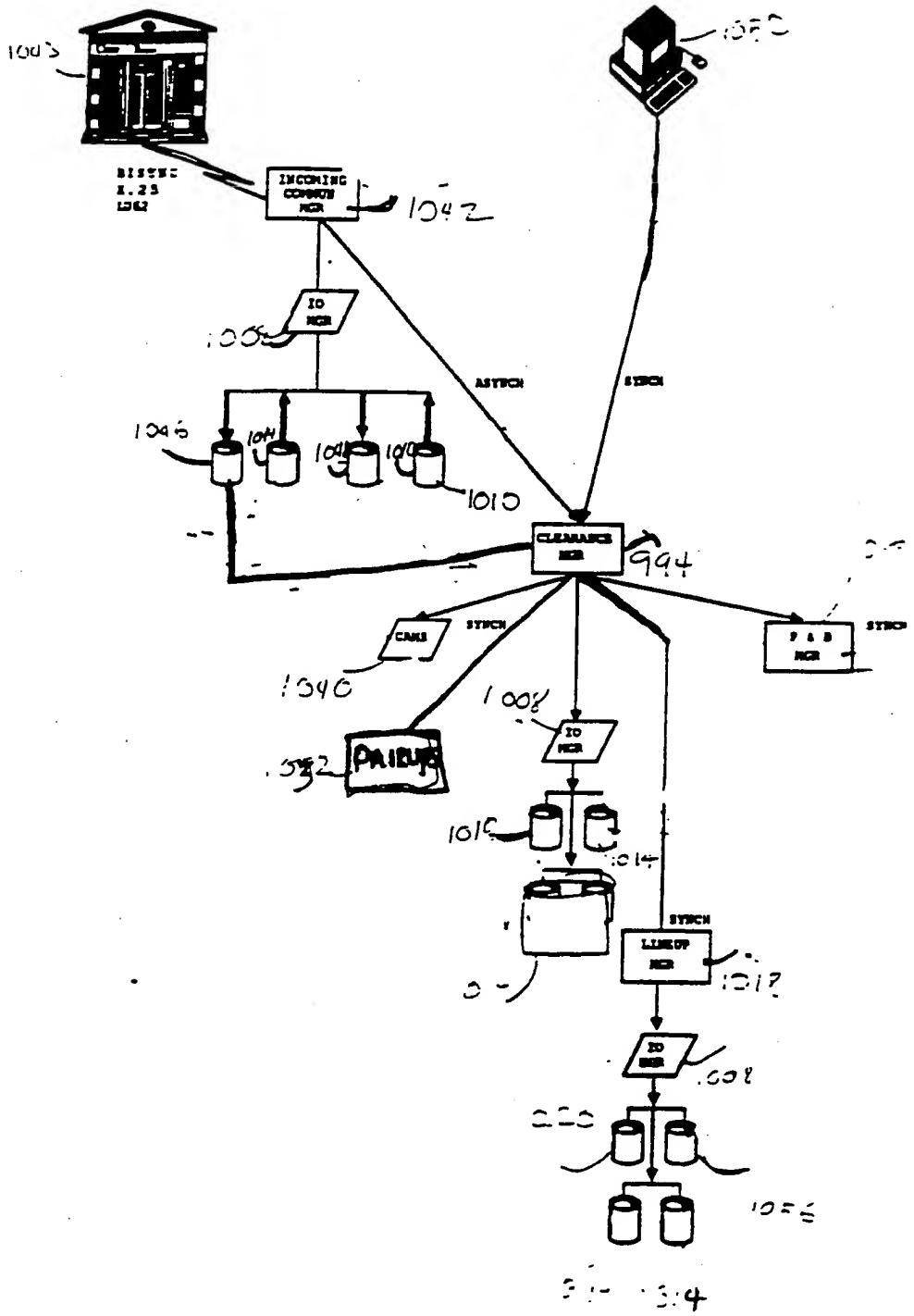


FIG 22C

FAILED TRADE CLEARS

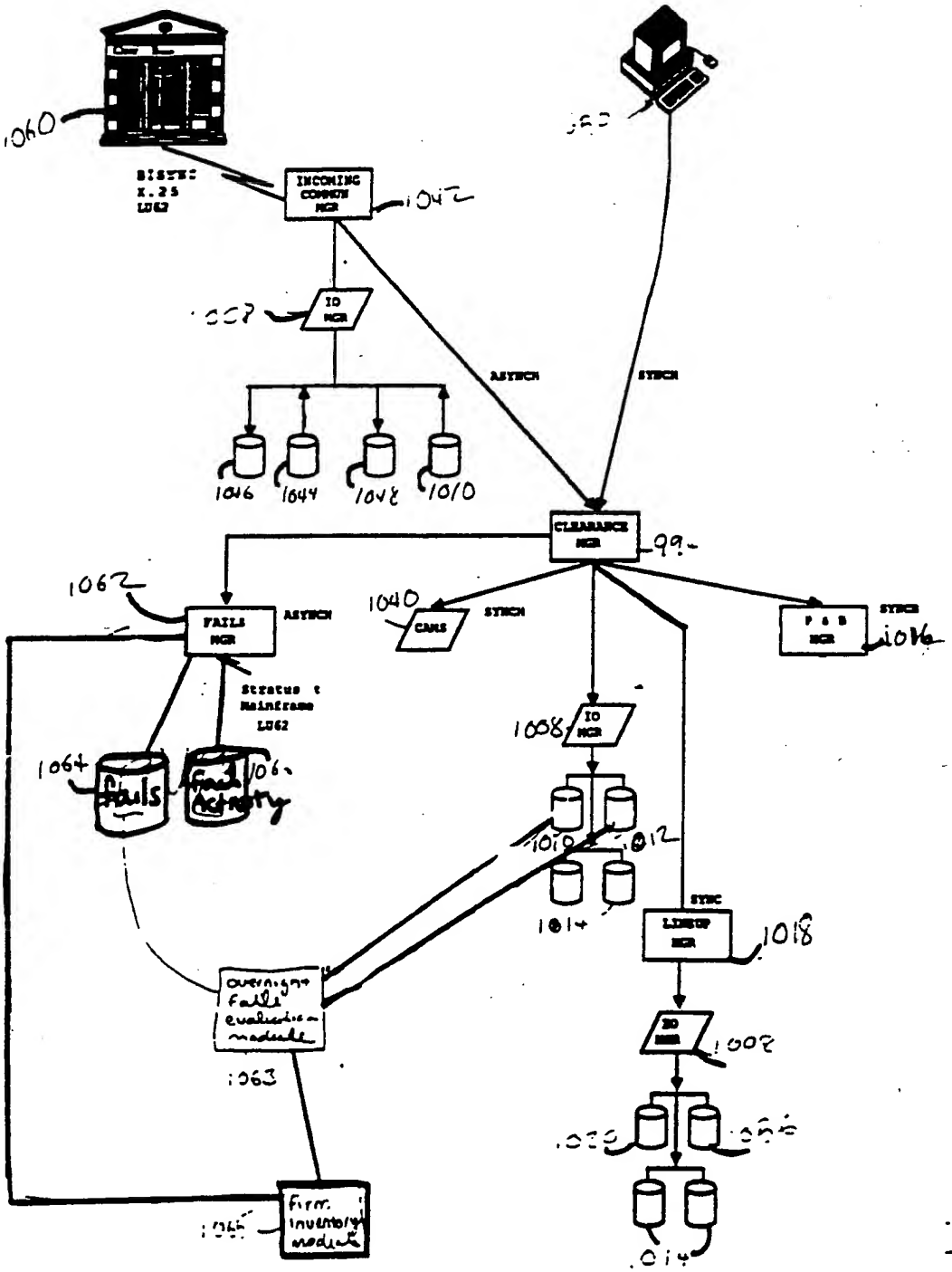
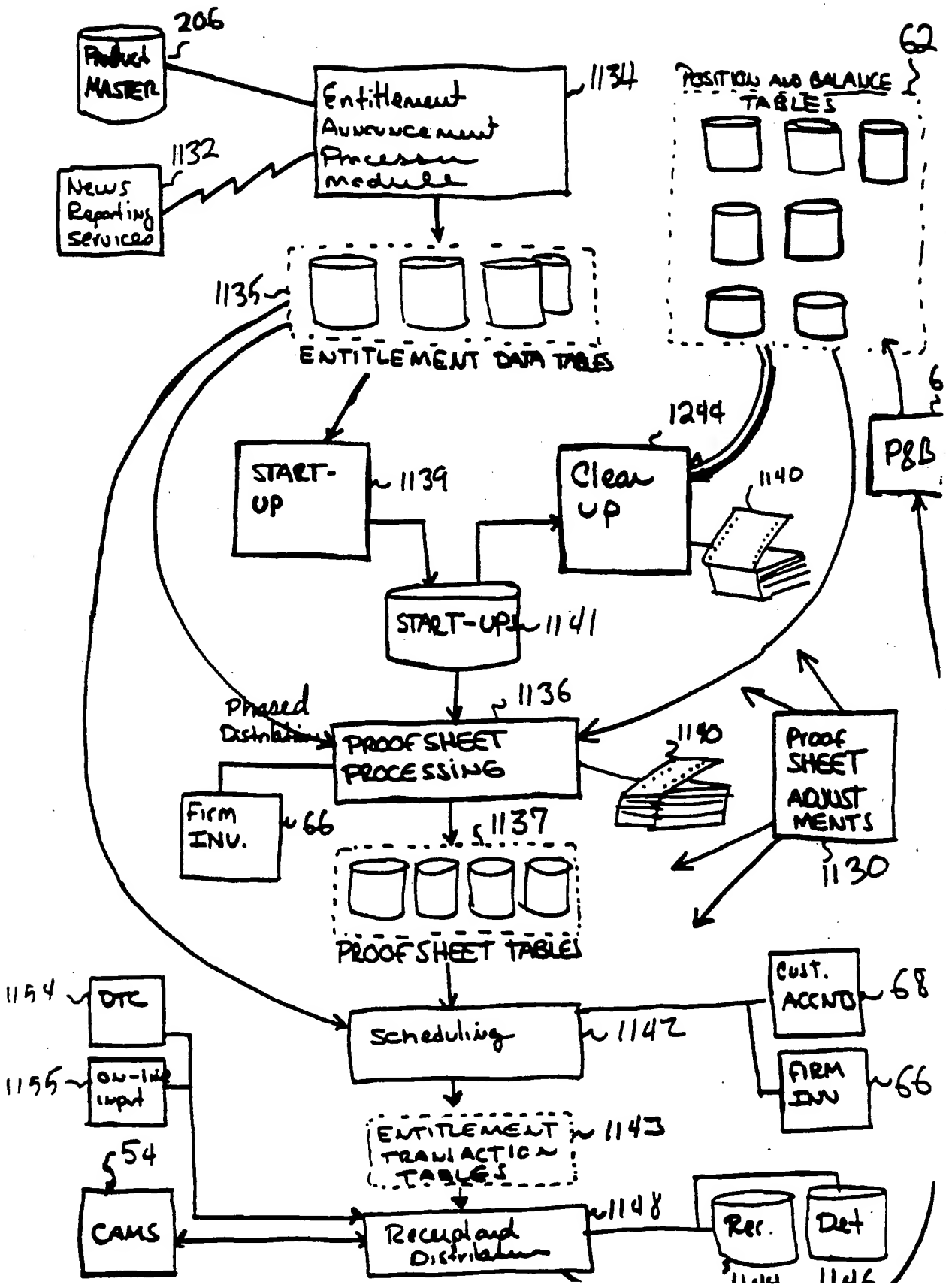
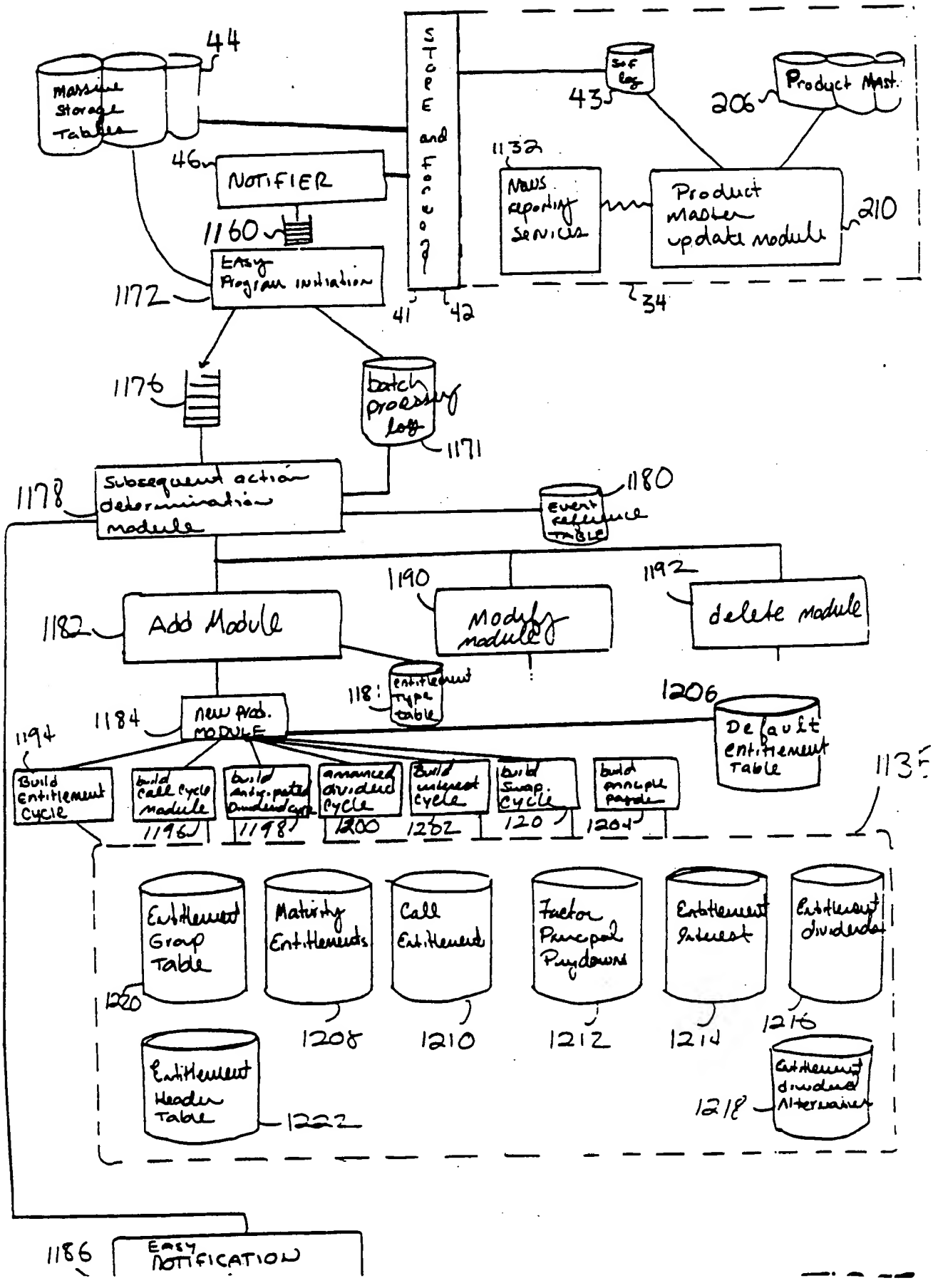


FIG 22d


206
Product MASTER
1134
Entitlement Announcement Processing Module
1132
News Reporting Services
62
POSITION AND BALANCE TABLES
1135
ENTITLEMENT DATA TABLES
1144
START-UP
1139
Clean up
1140
P&B
START-UPS
1141
1136
Phased Distribution
PROOF SHEET PROCESSING
1150
Proof SHEET ADJUST MENTS
1130
FIRM INV.
66
1137
PROOF SHEET TABLES
1154
DTC
1155
on-line input
54
CAMS
Scheduling
1142
CUST. ACCTS
68
FIRM INV
66
ENTITLEMENT TRANSACTION TABLES
1143
Receipt and Distribution
1148
Rec.
Det


44
Massive Storage Tables
STORE and FORWARD
43
SOF log
206
Product Mast.
46
NOTIFIER
1132
NAWS reporting SERVICE
Product Master update module
210
1160
Easy Program initiation
1172
41
42
34
1176
batch processing log
1171
1178
Subsequent action determination module
1180
Event reference TABLE
1190
1192
1182
Add Module
Modify module
delete module
118
entitlement type table
1206
1184
new prod. MODULE
Default entitlement Table
1194
Build Entitlement Cycle
build Call cycle module
build any-rated dividend cycle
amount dividend cycle
build interest cycle
build Swap cycle
build principal payden
1196
1198
1200
1202
120
1204
113
Entitlement Group Table
1208
Maturity Entitlements
1210
Call Entitlement
1212
Factor Principal Paydowns
1214
Entitlement Interest
1216
Entitlement dividends
1220
Entitlement Header Table
1222
Entitlement dividend Alternative
1218
1186
EASY NOTIFICATION

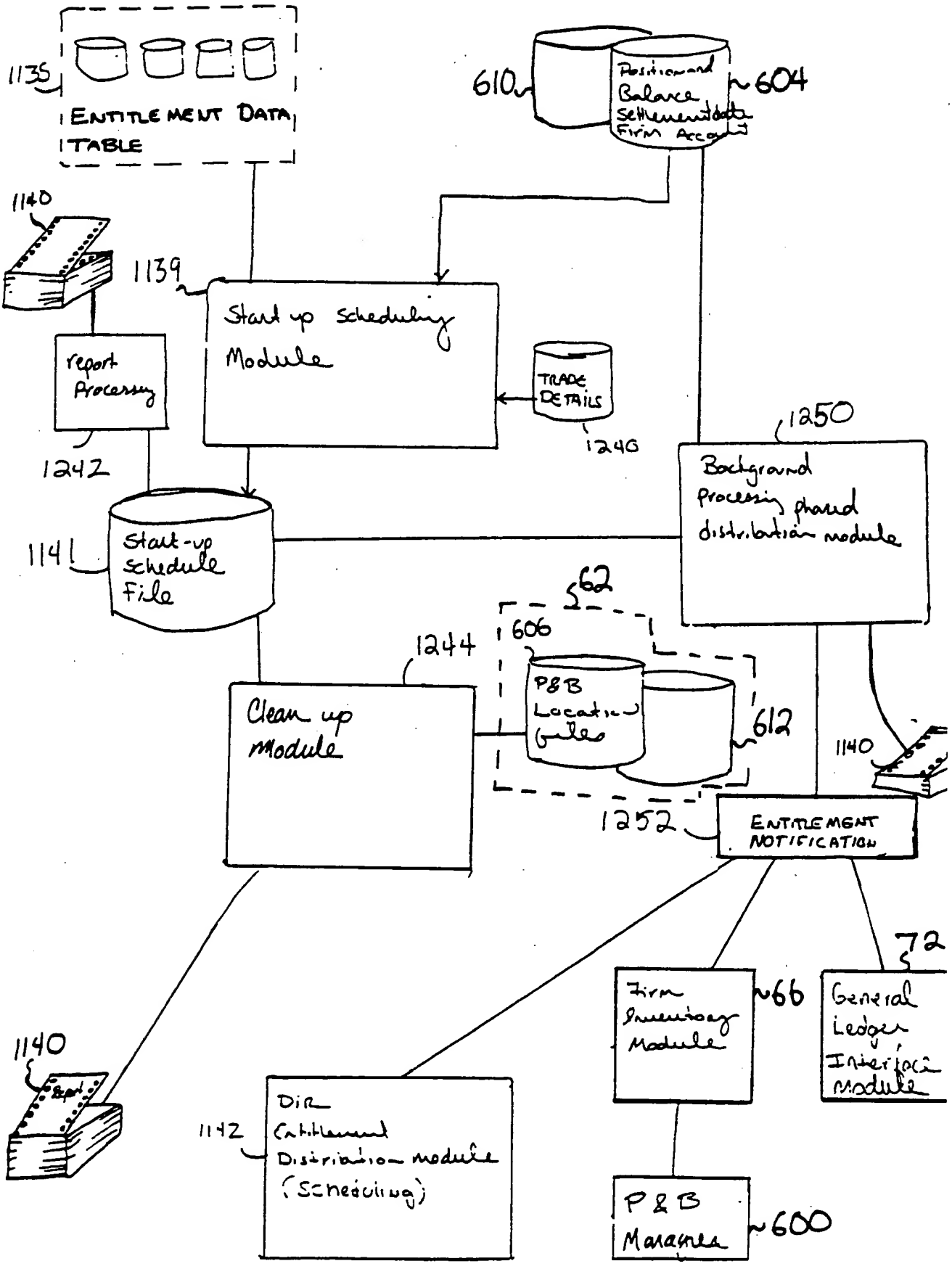

1135
ENTITLEMENT DATA TABLE
610
Position and Balance Settlement data Firm Acct
604
1140
1139
Start up scheduling Module
report Processing
TRADE DETAILS
1240
1242
1250
Background processing shared distribution module
1141
Start-up schedule File
62
606
1244
P&B Location files
612
Clean up Module
1140
1252
ENTITLEMENT NOTIFICATION
72
Firm Inventory Module
66
General Ledger Interface Module
1140
1142
DTR Entitlement Distribution module (Scheduling)
P & B Manager
600

FIG 23b

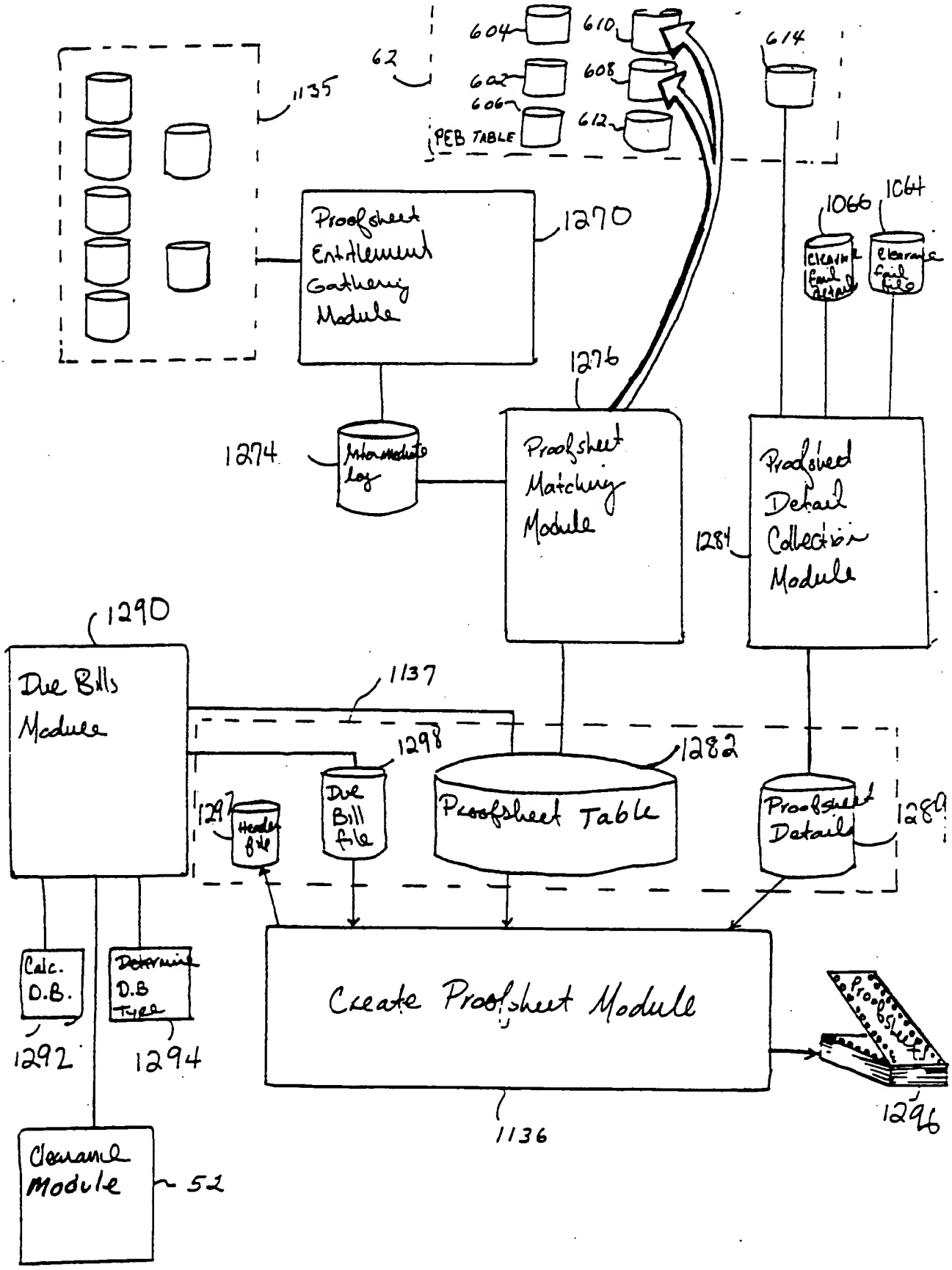
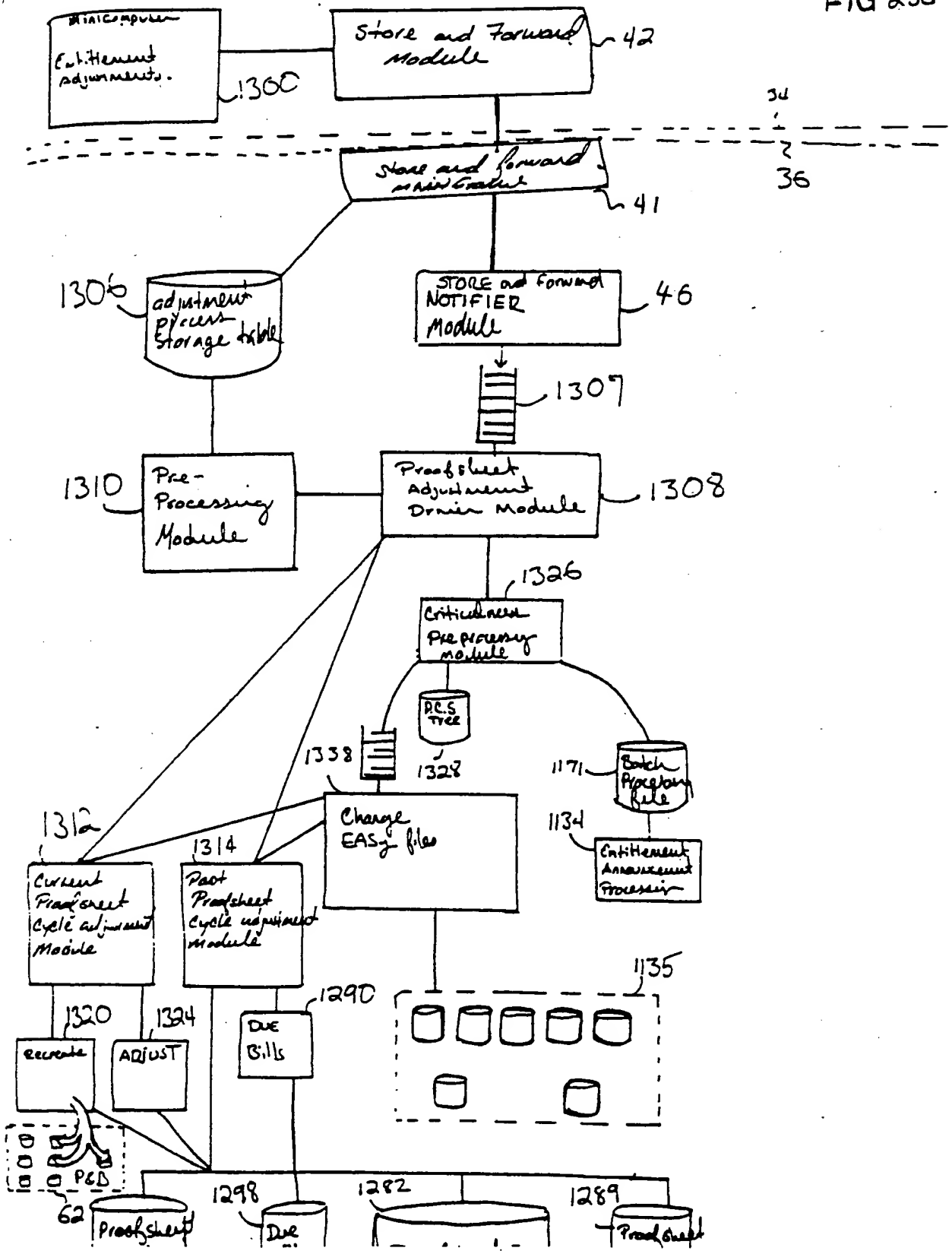

62
604
610
614
602
608
606
612
PEB TABLE
1135
1270
Proofsheet Entitlement Gathering Module
1066
1064
1276
1274
Intermediate log
Proofsheet Matching Module
1284
Proofsheet Detail Collection Module
1290
Due Bills Module
1137
1298
1282
1297
Header file
Due Bill file
Proofsheet Table
Proofsheet Details
1289
Calc. D.B.
Determine D.B Type
1292
1294
Create Proofsheet Module
Proofsheets
1296
1136
Clearance Module
52

FIG 23c

FIG 23d


Store and Forward Module
42
1306
adjustment process Storage table
STORE and forward NOTIFIER Module
46
41
36
1307
1310
Pre-Processing Module
Proofsheet Adjustment Driver Module
1308
1326
Critical area Pre processing module
1338
1328
1171
Batch Program file
1312
1314
Charge EASy files
1134
Entitlement Announcement Processor
Current Proofsheet cycle adjustment Module
Past Proofsheet cycle adjustment module
1135
1290
1320
1324
Recreate
ADJUST
DUE Bills
PCD
62
1298
1282
1289
Proofsheet

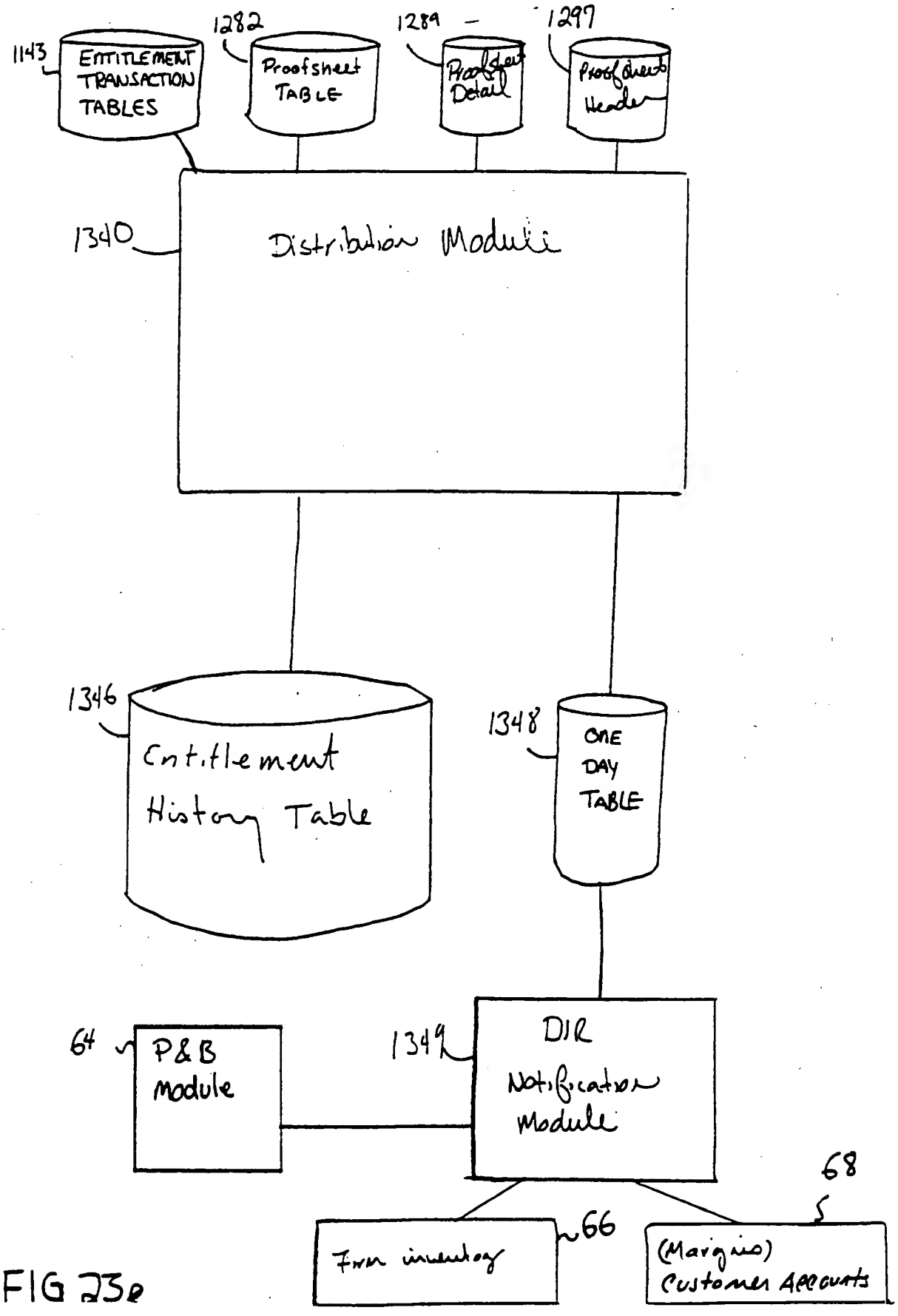
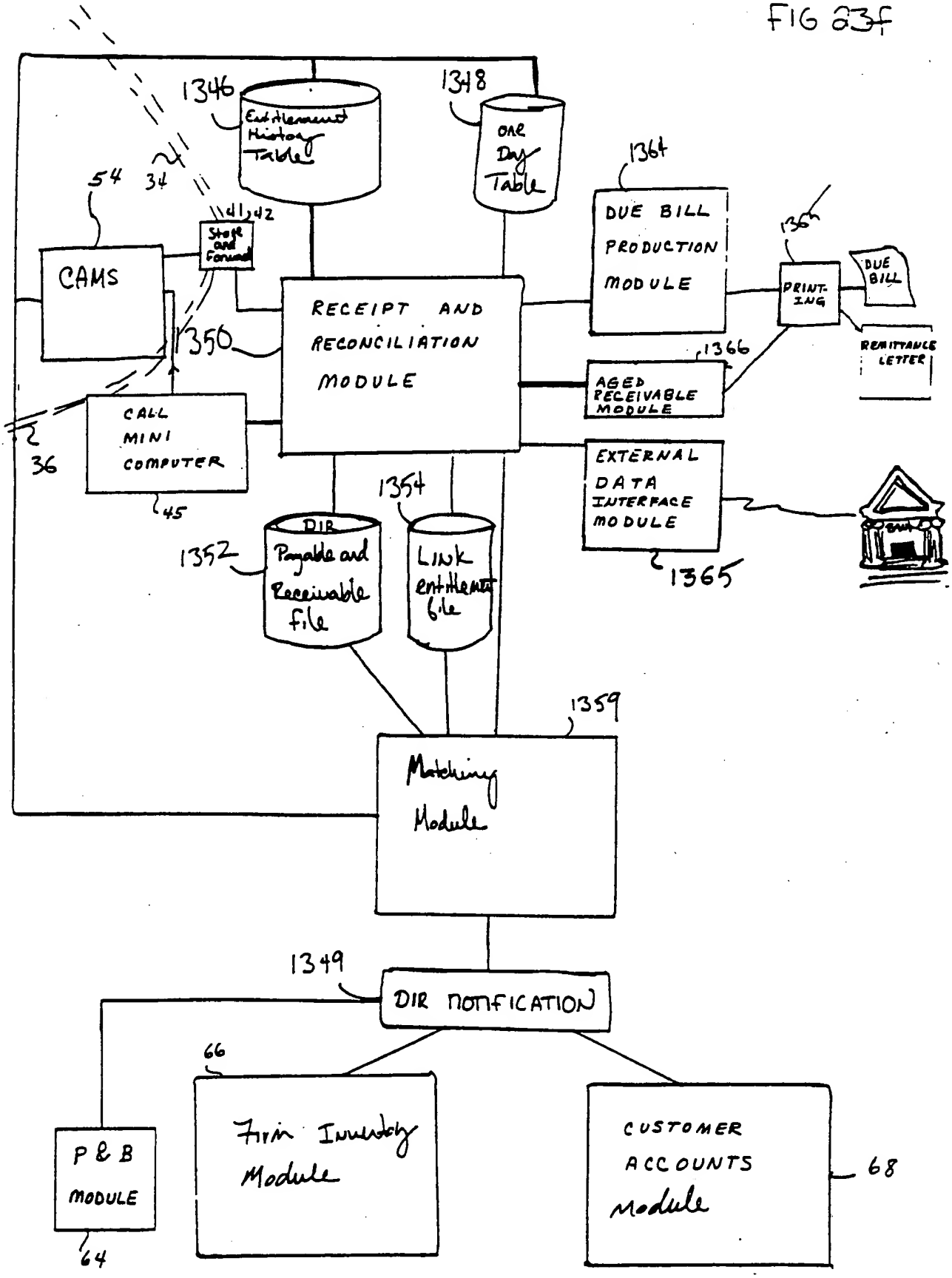
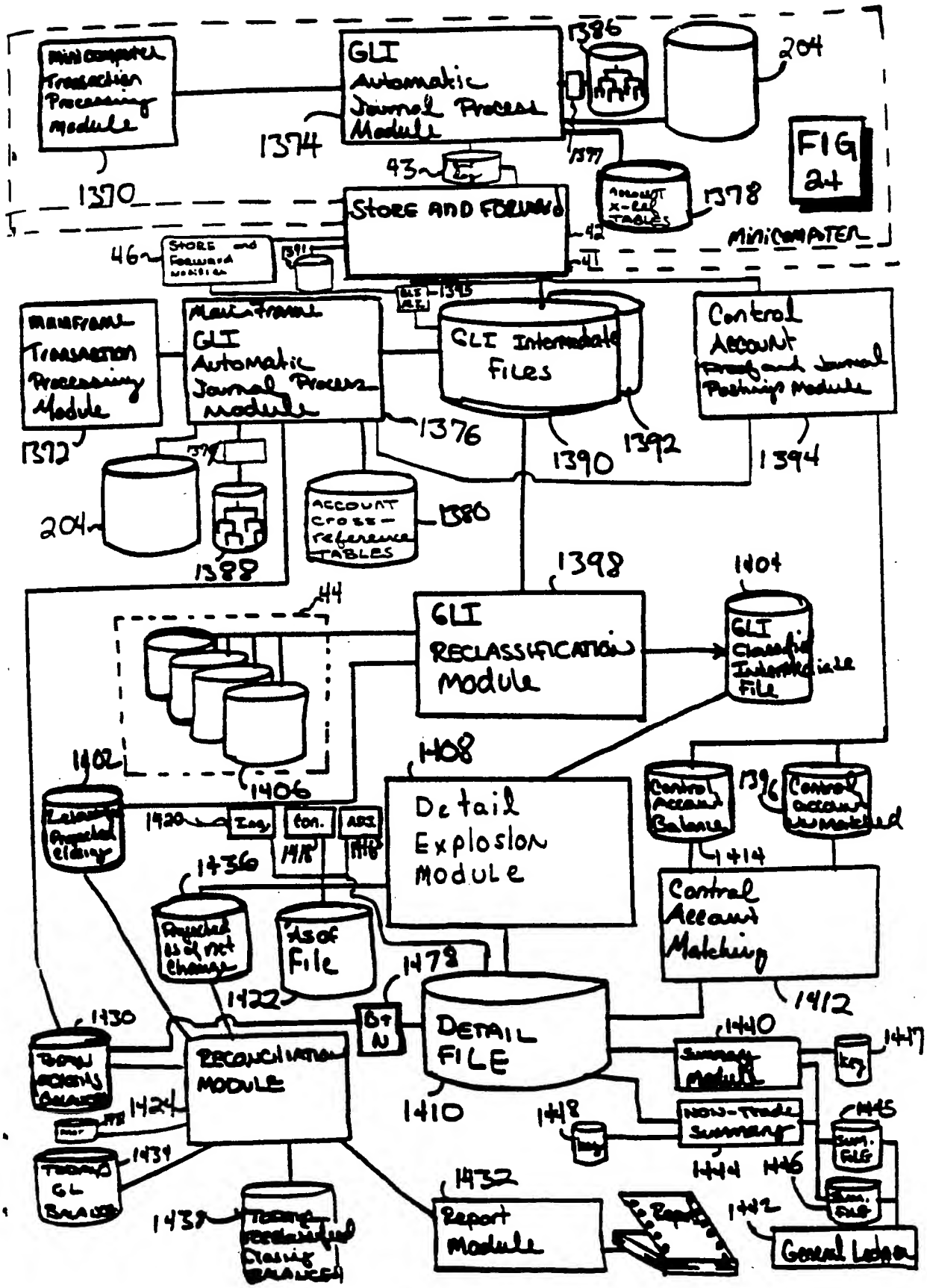

1143
ENTITLEMENT TRANSACTION TABLES
1282
Proofsheet TABLE
1289
Proofsheet Detail
1297
Proofsheets Header
1340
Distribution Module
1346
Entitlement History Table
1348
ONE DAY TABLE
64
P&B Module
1349
DIR Notification Module
68
66
From inventory
(Margins) Customer Accounts

FIG 23e

FIG 23f


1346
Entitlement History Table
1348
ONE Day Table
1364
DUE BILL PRODUCTION MODULE
136
PRINTING
DUE BILL
REMITTANCE LETTER
54
34
41, 42
Store and Forward
CAMS
1350
RECEIPT AND RECONCILIATION MODULE
1366
AGED RECEIVABLE MODULE
CALL MINI COMPUTER
36
45
EXTERNAL DATA INTERFACE MODULE
1365
1354
DIR
1352
Payable and Receivable file
LINK entitlement file
1359
Matching Module
1349
DIR NOTIFICATION
66
P & B MODULE
64
Firm Inventory Module
CUSTOMER ACCOUNTS Module
68


Minicomputer Transaction Processing Module
GLI Automatic Journal Process Module
1374
1386
204
1377
43
1378
1370
Store and Forward
MINICOMPUTER
46
42
41
Mainframe Transaction Processing Module
Mainframe GLI Automatic Journal Process Module
GLI Intermediate Files
Control Account Proof and Journal Postings Module
1376
1390
1392
1394
1372
204
1388
Account Cross-reference Tables
1380
1398
1404
GLI Reclassification Module
GLI Classified Intermediate File
44
1406
1402
1408
Detail Explosion Module
Control Account Balance
Control Account Unmatched
1416
1414
Control Account Matching
1420
Eng
Con.
ABS
1418
1436
Posted as of net change
As of File
1422
1478
1412
1430
Detail File
1440
1447
Reconciliation Module
1424
1410
1448
1445
1439
1444
1446
1432
Report Module
1442
General Ledger

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/06279

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): G06F 15/21

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.Cl	364/200,900 (MS FILE)

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US,A, 4,947,367 (CHANG) 07 AUGUST 1990, see entire document	29
Y	US,A, 4,903,201 (WAGNER) 20 FEBRUARY 1990 see entire document	1-7,9,15-18, 30 and 33
Y	US,A, 4,870,610 (BELFER) 26 SEPTEMBER 1989 see entire document	29
Y	US,A, 4,851,999 (MORIYAMA) 25 JULY 1989, see entire document	1-7,23-26, 32 and 33
Y	US,A, 4,815,030 (CROSS) 21 MARCH 1989, see entire document	1-7,10 and 33
Y	US,A, 4,646,229 (BOYLE) 24 FEBRUARY 1987, see entire document	8
Y	US,A, 4,631,664 (BACHMAN) 23 DECEMBER 1986, see entire document.	31

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

12 DECEMBER 1991

Date of Mailing of this International Search Report

30 DEC 1991

International Searching Authority

ISA/US

Signature of Authorized Officer

MARIA N. Von BUHR -Examiner

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	US,A, 4,623,964 (GETZ) 18 NOVEMBER 1986, see entire document	15-18,27 and 28
Y	US,A, 4,597,046 (MUSMANNO) 24 JUNE 1986, see entire document	8 and 15-18
Y	US,A, 4,554,418 (TOY) 19 NOVEMBER 1985, see entire document	1-7 and 33
Y	US,A, 4,479,196 (FERRER) 23 OCTOBER 1984, see entire document	31
Y	US,A, 4,412,287 (BRADDOCK) 25 OCTOBER 1983, see entire document.	13 and 14

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . because they relate to subject matter [12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers .... , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international sparch can be carried out [13], specifically:

3. ☐ Claim numbers_____, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	US,A, 4,376,978 (MUSMANNO) 15 MARCH 1983, see entire document	11 and 12
Y	US,A, 4,346,442 (MUSMANNO) 24 AUGUST 1982, see entire document.	11 and 12
A	US,A, 4,153,931 (GREEN) 08 MAY 1979, see entire document	1-33
Y	US,A, 4,135,241 (STANIS) 16 JANUARY 1979, see abstract; column 10; columns 46-74	32
Y	US,A, 3,596,256 (ALPERT) 27 JULY 1971, see entire document	27 and 28
Y	US,A, ,3,573,747 (ADAMS) 06 APRIL 1971, see entire document.	13 and 14
Y	US,A, 3,297,992 (McDONALD) 10 JANUARY 1967 see columns 99-110.	19-26